UNIVERSITY OF ALBERTA LIBRARY
0 0004 3286 905

SOCIAL STUDIES

INTERMEDIATE GRADES

BRUNER-SMITH

THE STORY OF TOOLS AND MACHINES
TRANSPORTATION AND COMMUNICATION
CONSERVING OUR NATURAL RESOURCES
WHAT IS MONEY?

SOCIAL STUDIES

INTERMEDIATE GRADES

BOOK THREE

BY

HERBERT B. BRUNER

PROFESSOR OF EDUCATION
IN CHARGE OF THE CURRICULUM LABORATORY
TEACHERS COLLEGE, COLUMBIA UNIVERSITY

AND

C. MABEL SMITH

SUPERVISING PRINCIPAL, PARKSIDE SCHOOL
SILVER SPRINGS, MARYLAND

CHARLES E. MERRILL COMPANY
NEW YORK CHICAGO

Printed in the
United States of America

Copyright, 1938,
By CHARLES E. MERRILL CO.

[2]

LIBRARY OF THE UNIVERSITY
OF ALBERTA

Educ
H
82
.C89
v.2.

PREFACE

The bewildering march of events in the last few years has brought forcefully to the attention of the people of our country the fact that we have many problems upon the solutions of which depend our security and our happiness. These solutions, if they are to be permanently helpful, must be worked out by the mass of the people. Only through realistic and vital education can this be accomplished. While much can and should be done to acquaint our entire present adult population with every element of the situation, the brightest hope for sound solutions undoubtedly lies in the education of the young. In fact, it is a major opportunity and obligation of the schools of America to see to it that the young people in their charge are far better equipped to deal with the troublesome issues which our country is facing than we adults have been. They must train our youth to cope with change — political, technological, social, economic, and aesthetic — in such fields as agriculture, transportation, housing, and feeding and clothing our people.

A sound social studies program, carefully planned and capably executed, seems to offer the best possibilities for realizing the aims stated above. Promising beginnings in this direction are appearing all over the country. School administrators and teachers have come to a sense of the ends to be achieved, and, to a degree, of the means by which they can be achieved. The chief determent to

118529

success in carrying out such programs as have been set up has been the lack of materials — materials which give an adequate description and interpretation of present social conditions and possibilities; materials so simply written that pupils would begin to gain a better comprehension of some of the simple but pivotal problems of American life; materials so complete that pupils would begin to see more clearly their place in the world of change, and to appreciate more keenly the experiences through which men have learned and are still learning to work and play together; materials sufficiently vivid and dramatic to captivate the interests of pupils and move them to active, constructive participation in rich group living appropriate to their age, abilities, and experiences.

The authors of these books are attempting to supply such material. The program presented in the series is based upon the theses: first, that a civilization to have virility must be thoroughly rooted in the culture of its own time; second, that a rich culture fraught with opportunities and difficulties now exists; third, that the curriculum of the American schools, especially in the field of the social studies, should capitalize upon the wealth of opportunities which today's culture presents; fourth, that pupils must be acquainted with the errors and successes of peoples of other times and other climes in order to gain proper perspective in viewing our problems of today; and fifth, that, in the light of their study of present and past conditions, pupils must learn to go forward looking forward.

Certain controlling themes have influenced the selection and presentation of the program of this series. These themes are as follows: (1) Man's Increasing Control

over Nature; (2) Man's Tendency to Move from Place to Place in Quest of a Higher Standard of Living; (3) The Increasing Interdependence of Peoples; (4) The Necessity of Man's Adaptation to Meet the Requirements of Subsistence, the Pressure of Competing Groups, and the Conditions Implicit in Change; (5) The Progress of Democracy.

Considerations of the nature of those raised above point the way to a program in social studies that is a decided departure from the courses in history and geography that have been the established custom in most school centers up to the present. They demand, furthermore, a program that is not a mere fusion of the established history and geography courses. A program that is the outcome of such considerations must be one in which fundamental understandings take precedence over fact as fact, which stresses change and development rather than exact, detailed pictures of any certain area or areas in time or place, which seeks to make pupils conscious of the story of human development as a story of the struggle of individuals or of groups with forces or factors in their environment, and which reveals to pupils that the present lies in the stream of that development and of that struggle, and that the future is dependent upon the part they themselves take in that struggle.

With these aims in mind, the authors have sought, in these intermediate grade books, to help the pupils to open up for themselves eleven significant aspects of living. Four of them are developed in Book One of the series: *The Story of Agriculture*, *The Story of Fire*, *The Story of the Sea*, and *The Story of Writing*. Book Two presents three units: *The Growth of the City*, *Feeding the Millions*,

and *The Story of Clothing.* Book Three presents four units: *The Story of Tools and Machines,* an account of how man has improved his methods of work from the primitive stage to the machine age; *Transportation and Communication,* the story of man's conquest of time and space; *Conserving Our Natural Resources,* an account of man's use of the earth's treasures; and *What Is Money?* a story of the way man has developed means of exchanging goods.

By vivid presentation through story and picture, pupils are led to feel the tremendous sweep of progress in each of these major areas of man's achievement. In connection with each section or subsection of a unit, suggested activities augment the text in developing understandings, appreciations, and attitudes and guarantee the connection between the pupils and their environment and the great forces of world development.

THE AUTHORS

TABLE OF CONTENTS

PAGE

PREFACE iii

UNIT I. THE STORY OF TOOLS AND MACHINES

SECTION I. THE IRON AGE 3
SECTION II. HOW MAN LEARNED TO MAKE TOOLS . . 17
SECTION III. NEW MACHINES AND NEW POWER . . 60
SECTION IV. THE INDUSTRIAL AGE 84
SECTION V. MACHINES — MASTERS OR SERVANTS? . 102

UNIT II. TRANSPORTATION AND COMMUNICATION

SECTION I. SPEED 121
SECTION II. MAN LEARNS TO TRAVEL 135
SECTION III. HIGHWAYS, WATERWAYS, AND RAILWAYS . 161
SECTION IV. COMMUNITY TRAVEL 193
SECTION V. TRANSPORTATION THROUGH THE AIR . . 207
SECTION VI. INSTANT COMMUNICATION 234
SECTION VII. WHAT ABOUT THE FUTURE? . . . 251

UNIT III. CONSERVING OUR NATURAL RESOURCES

SECTION I. THIS LAND OF OURS 269
SECTION II. A STORY OF BEGINNINGS 296
SECTION III. DISCOVERING A NEW STOREHOUSE . . 322
SECTION IV. OUR FARMS AND OUR FORESTS . . . 333
SECTION V. TREASURES IN THE EARTH'S CRUST . . 371
SECTION VI. PLANS FOR THE FUTURE 393

UNIT IV. WHAT IS MONEY?

PAGE

SECTION I. OUR MONEY CIVILIZATION OF TODAY . . 401
SECTION II. SATISFYING HUMAN WANTS . . . 420
SECTION III. HOW TRADE AND MONEY DEVELOPED . . 435
SECTION IV. CIVILIZATIONS USING LITTLE MONEY . . 473
SECTION V. MONEY AND TRADE TODAY . . . 499
SECTION VI. OUR GOVERNMENT AND OUR MONEY . . 529

A PRONOUNCING LIST 555

INDEX 559

UNIT I

THE STORY OF TOOLS AND MACHINES

Section I. The Iron Age . . . . . page 3
Section II. How Man Learned to Make Tools . . . . . page 17
Section III. New Machines and New Power . . . . . page 60
Section IV. The Industrial Age . . . page 84
Section V. Machines — Masters or Servants? . . . . . page 102

I. THE IRON AGE

Machines do much of our work today. They help to produce our food and our clothes, to build our homes, and to carry us from place to place. They make our work easier and our living more comfortable. Many machines are needed to do our work. They are powerful servants. It is said that the civilization of today is a machine civilization. Where do we get our wonderful machines? From what are they made?

MINING IRON ORE

An engine snorts and puffs! A huge shovel swings high in the air — a shovel large enough to hold a team of horses! Inside a little cabin sits Jake, who is in command of the engine. By moving levers and shifting gears, he directs the great shovel to answer his will.

At a movement of Jake's skillful hands, the huge scoop swings into position. It pauses for a moment, held high in air at the tip of a long steel arm. Slowly the big shovel moves down — down, down, until it rests on the ground. Then, suddenly, its jaws spring open and bite into the earth, scooping up a ton or more of iron ore. The ore piles up and then settles down, even with the sides of the shovel.

Once again Jake moves a lever. The shovel swings up from the ground and travels quickly to a position right over an empty car waiting upon a track. Once more its jaws open, and down tumbles the load of ore into the empty car.

Again and again the shovel swings high, swings low, bites the earth, rises, and empties. Car after car is filled. To a watcher, the shovel moves like a thing alive; but inside the cabin are Jake, with his clever brain and hands, and the engine which provides the power.

What are Jake and his shovel doing? Where are they working?

The Mesabi Range in the state of Minnesota is one of the biggest iron-producing regions in our country. It is a region of open-pit mines. Rich ore lies in beds just beneath the surface of the earth where it can be mined easily with pick and shovel. But Jake and his steam shovel can mine the ore faster than many men. Indeed, many shovels like Jake's surround the ore pits, so eager are men for the valuable ore. Each shovel takes its bite from the earth many times in a day. Each shovel has its own train of empty cars to fill again and again throughout each day.

What becomes of these trainloads of ore? Suppose we find out.

Lake Superior juts into Minnesota, and at its western tip lies the great lake port of Duluth. Find this important city on a map in your geography.

Courtesy Carnegie-Illinois Steel Corporation

MINING ON THE MESABI RANGE

Great ore docks border the lake front of Duluth — docks at whose edges are many bins for storing iron ore until it is ready to be loaded into the ore freighters which travel our Great Lakes.

Suppose we follow one of Jake's ore trains down to the docks at Duluth. The train is a long one of nearly a hundred cars. For eighty miles it rattles on its way to the ore docks of Duluth. Upon reaching the docks, it is run out on a trestle track over the open ore bins. It comes to a halt, the bottoms of a number of cars slide open, and each load drops into a bin. Slowly the train moves forward, and more cars drop their loads into the yawning bins.

All through the day the ore trains bring their tons of ore and drop them into the bins — Jake's trains, and all the trains loaded by the other shovels that are biting into the iron-laden earth. From the ore pit to the bins no human arms have lifted a pound of ore, no backs have been strained, and no muscles stretched. The watchful eyes, the clever brains, and the skillful hands of a few men have guided machines to perform the enormous task of filling the waiting bins.

Up to the ore dock steams an ore freighter — a ship six hundred feet long, with a hold great enough to carry twelve thousand tons of ore. Twelve thousand tons of ore! That is surely a heavy cargo. Yet Jake and his fellow workers have sent that much ore and more to the ore bins on the docks. Won't it take a very long time to stow twelve thousand tons of ore into the hold? Watch a moment. The hatches of the ship are opened. A dozen or twenty chutes are lowered from the funnel-shaped bins, and down streams the ore through the hatches into the hold! In twenty minutes twelve thousand tons of ore have been transferred from the bins on the dock to the hold of the ship. During the months when the Great Lakes are free from ice, an ore freighter may get in and out of the harbor of Duluth so rapidly that the captain hardly has time for a meal ashore. Indeed, the cooks complain because they haven't enough time in which to buy provisions for the next trip.

Courtesy Carnegie-Illinois Steel Corporation

ORE FREIGHTERS

The upper picture shows two freighters at the docks at Duluth, ready to receive their cargo of iron ore. The lower picture shows ore freighters traveling between Duluth and Cleveland.

Bourke-White from Pictures, Inc.

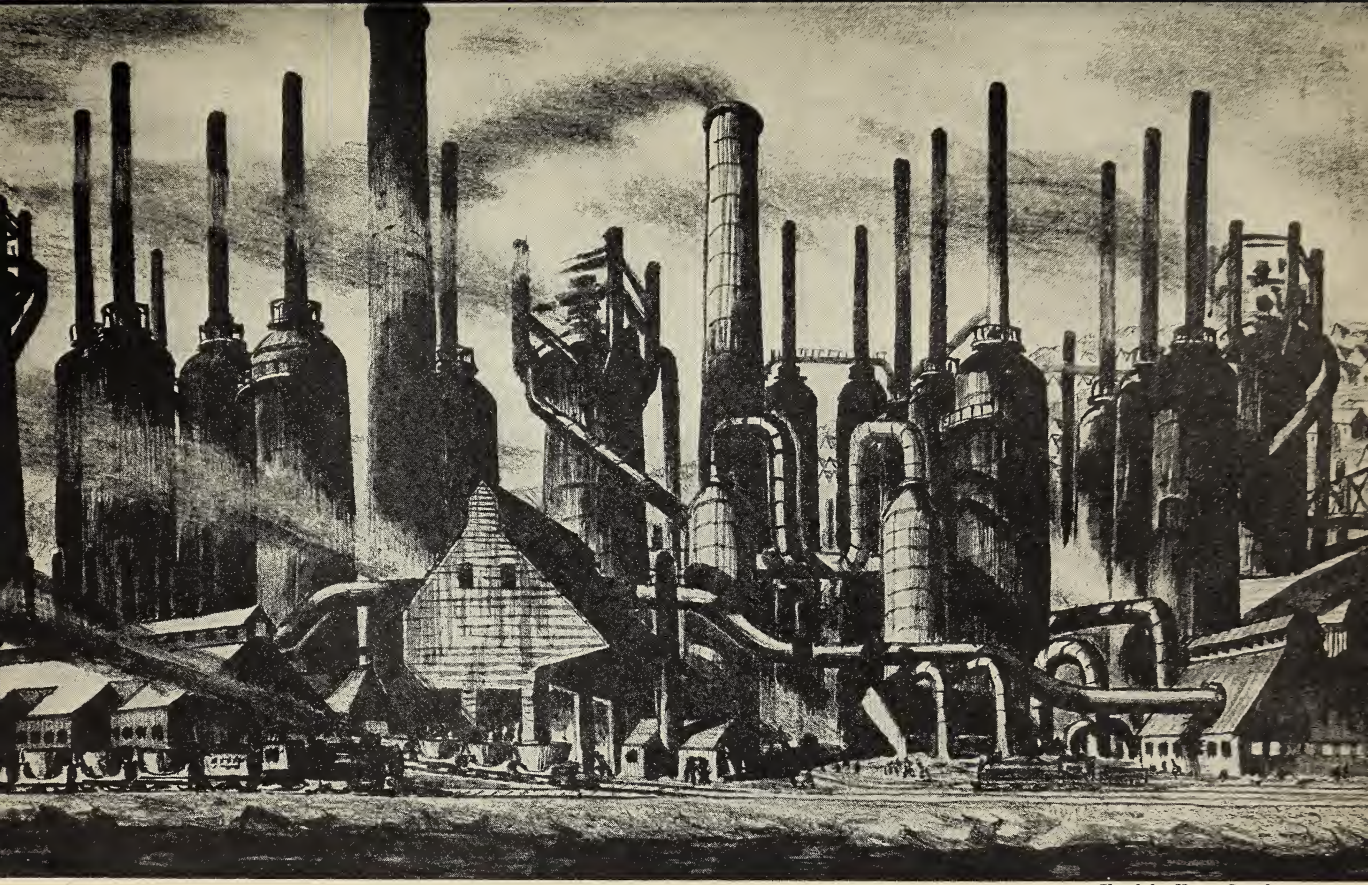
At the docks at Cleveland the cargo of ore is rapidly unloaded from the hold of the ship. The huge arm of an unloading crane reaches down. A scoop digs into the ore in the hold, and the crane lifts the load and drops it into a waiting car. In a short time the ore freighter is empty of ore and its cargo is at the Cleveland smelting works.

FROM ORE TO STEEL

What is this red material, which we call iron ore, composed of? It is made up partly of iron and partly of other metal, carbon, soil, and impurities. At the smelting works it must go through two processes. In the first process, the iron is separated from the other materials contained in the ore. In the second, the iron is made into steel.

How are these processes performed?

First, the ore must go to a *blast furnace.* Every steel plant has its rows of blast furnaces — round, chimney-like structures, wider at the base than at the top, and sometimes as tall as a hundred feet. The picture on the opposite page gives you a fine impression of the appearance of the blast furnaces at a smelting plant. A furnace is built of bricks and held together by iron bands. Cable cars run to the top of the furnace on an inclined track. They carry raw materials which are to be dropped into the furnace below. First a layer of coke is dropped into the furnace, then a layer of limestone, and then a layer of ore, until the furnace is full.



Sketch by Harry Sternberg

BLAST FURNACES AT A STEEL PLANT

Near the blast furnaces are huge stoves, or heaters, which heat air to an intense degree. The hot air from these heaters is blasted into the furnaces at the bottom. As it rises through the layers of coke, it sets free the gases in the coke. These hot gases rise to the top of the furnace, setting free other gases in the iron ore. Heat and gases combine to separate most of the impurities from the ore. The iron melts and trickles down through the layers of limestone and coke. The gases that have been formed are carried out of the furnace by a pipe. Some of the impurities mix with the limestone and become slag. At the bottom of the furnace the melted iron is drained off by a pipe. The slag floats on top of the melted iron and is therefore easily separated from it. The melted iron is sent through a pipe into a huge kettle, or caldron, and the slag goes into another caldron. The melted iron is called *pig iron.*

It is not easy to understand the process of changing iron ore to pig iron from just reading the above description. Study the diagram on the opposite page to help you understand the process.

The pig iron is given a second heating in either a Bessemer converter or an open-hearth furnace. At this time the pig iron is freed of more impurities and is mixed with the right amount of carbon. It is then poured into molds and cooled. The iron ore which left the Mesabi Range has become steel. It is ready to be used for the making of many things, from skyscrapers to nails.

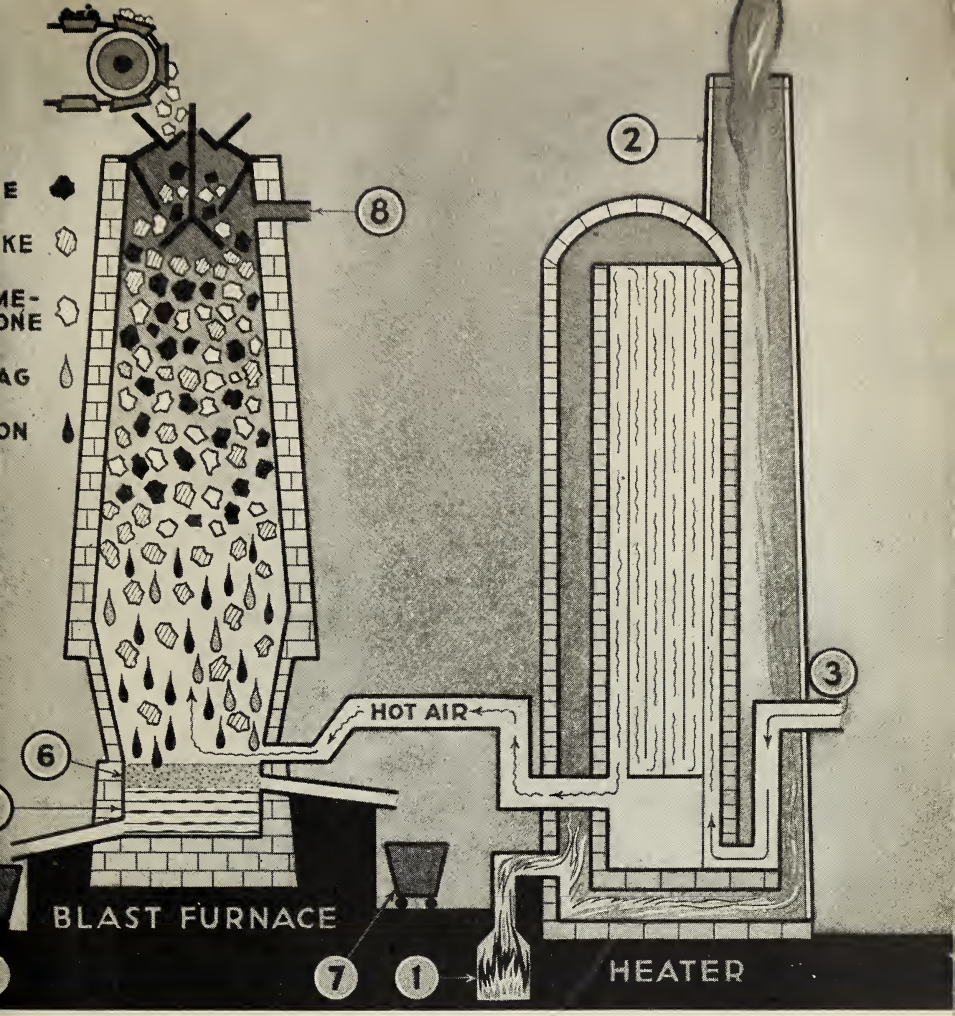


DIAGRAM OF A BLAST FURNACE

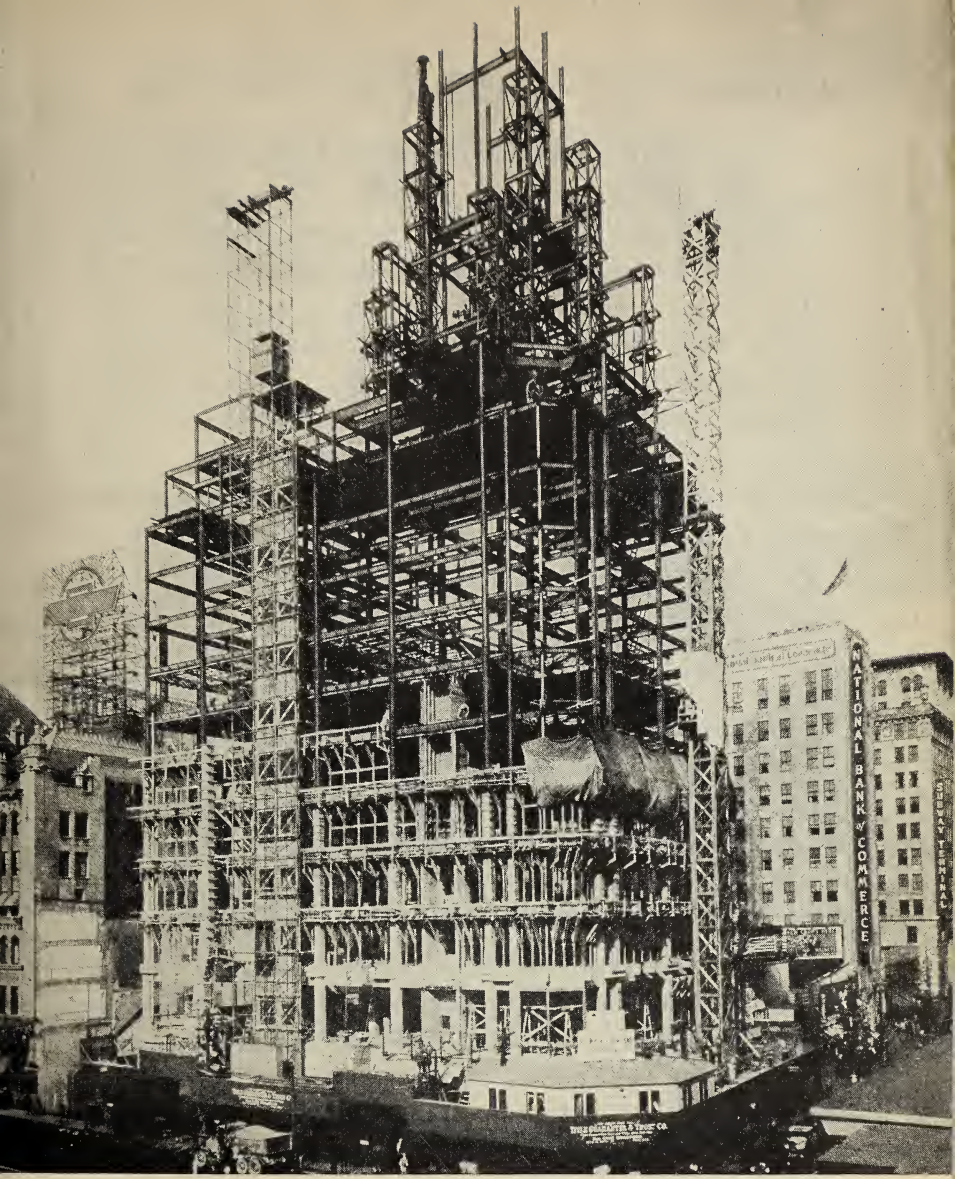
Study the Key in the upper left corner. It explains the contents of the furnace. Then study the Key below. It will help you to see how the furnace operates.

1. Gas burner that supplies heat
2. Chimney
3. Cold-air intake
4. Pig iron
5. Iron caldron
6. Slag
7. Slag caldron
8. Gas outlet

Courtesy National Steel Corporation

STEEL PRODUCTS

Sheets and bars of steel like those above, as well as structural parts like those in the lower picture, are used in making the framework of skyscrapers like the one on the opposite page.



Courtesy Consolidated Steel Corporation, Ltd.

A SKYSCRAPER IN THE MAKING

At this stage in its building, the skyscraper shows plainly its structural steel framework. A single large skyscraper in one of our great cities will use over fifty thousand tons of steel.

We are living today in an age of iron and steel. Our civilization depends upon these materials. Everywhere about us we see iron and steel made into articles of use. We see steel bridges and steel rails. We see skyscrapers supported by huge steel girders. We see transportation vehicles — trucks, automobiles, trains, ships, airplanes — all made, in part, of steel. Steel is used in the building of our houses and in the making of some of the furnishings for our homes. It would be hard for us to get along without the things that are made from steel.

But probably the most important use of steel is in the making of our tools and machines, for with these are made all of the things mentioned in the paragraph above. Steel saws cut our lumber. Steel shovels dig our iron ore. Steel machines weave cloth for our clothing. Steel rolling machines grind our flour. Steel machines are used in making nearly everything we have. Steel is the only material which is plentiful enough and strong enough to make the great machinery we are using today. Steel makes our machine civilization possible.

Uses of Iron. I. The quantity of iron and steel produced in our country each year is said to amount to about a half ton for each person in the country. Tell some of the ways in which you use your share of this iron or steel. List the articles made of iron and steel that you use most.

II. Choose one vehicle in which you have ridden. List five or more of its parts which were made from iron or steel. Tell why iron or steel was used.

III. What is the difference between iron and steel?

IV. Collect pictures of modern tools and machines made of iron and steel. Write a paragraph telling about the use of iron in making tools and machines.

The Sources of Iron. I. On an outline map of the world, color the great iron-producing regions. You can find out about these regions in your geography. By some method show those regions that are being developed at the present time and those that are still undeveloped. Tell the reasons why some regions are undeveloped.

II. Find, by reading in your geography, the parts of the United States where iron ore is mined. Mark them on an outline map of the United States. Find out also how much iron ore is produced in our country each year. Does any other country produce more per year?

Changing Iron Ore into Articles of Use. Select one of the topics listed below and prepare a report on it. Find the necessary facts in an encyclopedia or some other reference book.

1. Different methods of mining iron ore.
2. How iron ore is made into pig iron.
3. Making pig iron into steel.
4. The use of steel in building skyscrapers.
5. Some men who have helped to develop the steel industry.

The Importance of Iron. In olden times iron was used for money in place of gold. It was so precious that people mentioned their iron pots and knives in their wills. Can you guess why people considered such things so precious at that time?

Making an Outline. Reread pages 3–14. Make an outline of the story. Decide your main topics first; then supply the sub-topics. Your outline may begin like this:

I. Getting ore at the Mesabi Range
   A. How the ore is mined
   B. Sending the ore to the docks at Duluth
II. ?

Reading about Iron and Steel. The following books contain some facts about the production of iron and steel or about tools and machines. Try to find these books in your school library or in your local public library. If you can, have them placed in your classroom for reference while you study this unit.

Great Inventors and Their Inventions by Frank P. Bachman

Compton's Pictured Encyclopedia

Our Earth and Its Story (Pathways in Science, VI) by Gerald S. Craig and Goldie M. Johnson

Thinkers and Doers by Floyd L. Darrow

Stories of Useful Inventions by Samuel E. Forman

The World We Live In and How It Came to Be by Gertrude Hartman

Man's Long Climb by Marion F. Lansing

Making Life Secure (Follett Social Science Readers, Number 7) by James V. Nash and Harley W. Mitchell

Dan-Hur and the First Farmers by William L. Nida

The Story of Long Ago by Gertrude and John Van Duyn Southworth

II. HOW MAN LEARNED TO MAKE TOOLS

Each time that man has discovered a new material or a new tool to serve his purpose, he has improved his conditions of living. His ability to make and to use tools has made civilization possible. How did man learn to make and to use tools? From what materials did early man make his tools?

MAN A TOOLMAKER

Have you watched a dog eat his dinner? He pokes his bone with his nose, moving it about on the ground so that he may better tear the meat from it. He holds it tight against the ground with his paws to keep it from slipping away from his eager mouth. With his sharp teeth he gnaws at it until every shred of meat is eaten. He does not pick the bone up in his paws and raise it to his mouth. Neither does he leave it on the ground and use a knife and fork to cut the meat from the bone. A nose, a mouth, and four paws are the dog's only means for eating. In fact, they are also the dog's only weapons of defense.

At one time man's equipment for living was not much better than that of the dog. With his bare hands man picked berries and gathered plants for

food. With his bare hands he dug up roots. With his bare hands he seized the small animals, tore them apart, and stuffed the bits into his mouth.

Man was more fortunate than the beasts, however, for he had a hand that could grasp — a hand that could clutch and hold an object. The thumb of man is placed opposite his fingers, and it can move in an opposite direction to them. We speak of it as the *opposing thumb*. Because he had an opposing thumb, early man could clutch a club, could grasp and throw a stone, and could pick up a stick and dig with it. The club, the stone, and the stick could therefore become tools or weapons in the hands of man. The opposing thumb is one gift that makes man different from the animals — different from them and superior to them — for the opposing thumb makes it possible for him to use tools.

Man was very fortunate in another way, too. He had a mind with which he could think and plan and learn new ways of doing things. Because of this remarkable gift, man could learn to do more than *use* tools — he could learn to *make* them, too.

What a task early man had! He had to learn all the tricks of living well — how to get better food; how to clothe himself; how to make houses and furnish them; how to travel and amuse himself; and how to keep himself well. He had all these things to do, and yet he had no tools or machines at first with which to work. But with his hands that could grasp and with his thinking mind, he was able

to provide himself with many kinds of tools and machines — those that he could use *for grasping* and *holding;* those that he could use *for striking* and *pounding;* those that he could use *for cutting;* those that he could use *for shaping* objects and *for weighing* and *measuring* them; and those that he could use *for moving* objects. He was often able to improve his tools, too. He learned to make them in new forms. He discovered how to make them of new materials. Whenever the tools and machines which he had made did not suit him, he could invent better ones. Man was indeed fortunate!

We do not know how it happened that man began to use tools. Probably it was by accident that someone discovered that a stone would crack a nut or crush grain or splinter a rock. But whatever led to the discovery, it meant the invention of the first tool for striking or pounding. A stone became a tool that could strike harder than the fist could ever strike; a tool that had power; a tool that protected the hand that held it; a tool that could reach farther than the hand of man could reach.

The first tools were not shaped by the hand of man. They were the stones or clubs that man found lying on the ground. Perhaps they were not at first selected carefully for the work they were meant to do. They may have been tools which could not be easily handled; tools which were not balanced correctly; tools which were blunt and dull. But man learned the important fact that tools were

useful; and as centuries passed, he came to select his tools with care and even to improve them.

For some three hundred thousand years or so man has been learning to use tools and to make them. The tools that he has invented have helped him to build up civilization.

The Tools of Animals. Explain what tools or weapons of man serve the same purposes as: (1) a bear's paw, (2) a cat's claw, (3) a dog's teeth, (4) a deer's horns, (5) an elephant's trunk, (6) an elephant's tusks.

The Opposing Thumb. I. Explain by means of your own hand what is meant by the opposing thumb.

II. Make a list of some things which you can do with your hand which neither a dog nor a cat can do. Why is it possible for you to do these things?

The Thinking Head. I. Explain why early man could make tools. Show the steps of thinking he might have taken in planning some common tool.

II. Mention some things that you have heard which might lead people to believe that animals can think. Tell of some tricks that animals have learned to do.

Man a Tool User. I. Explain why man may be called a tool-using and a toolmaking animal.

II. Make a list of the things which you can think of that man may have used for tools in very early days.

III. Can you think of any tools or weapons which we use today which have not been greatly changed since man began to use them?

EARLY MATERIALS FOR TOOLS

The early men made their tools from the things that they could see — those things that lay in plain sight above the ground. Can you imagine the long, long years in which men experimented with sticks, stones, shells, and bones, trying to make them into tools? Think of the years it must have taken them to discover that some stones are harder than others; that green wood will bend without breaking; that fire will harden wood if it is heated slowly and not too long; that a stick with a knot on one end makes a good weapon. These things were not easy to learn.

Some people divide the length of time during which man has lived on the earth into periods, each of which extends over many hundreds of years. Each period was a stage of man's development as he climbed upward toward civilization.

The present period of time is often called the *Iron Age* because the tools and machines of today are largely made from iron and steel. The Iron Age is man's most advanced stage of civilization.

The period before the Iron Age is often spoken of as the *Bronze Age* because many of the tools of man were made of bronze. During the Bronze Age, many of the people of the earth were becoming civilized. Some had built up fine civilizations.

The period before the Bronze Age may be called the *Smooth Stone Age.* During that period man learned to make his tools of polished flint. The people of the Smooth Stone Age were becoming

civilized. Some of them were still rough and uncultured, but they were not savages. They had good tools, and they had learned many of the arts of civilization.

The period before the Smooth Stone Age may be called the *Rough Stone Age*. During that period, which was many thousands of years ago, the people were savages, living in caves. Many of them were nomads, just wandering about. Most of them were hunters. They used only crude stone tools.

At the beginning of the Rough Stone Age, men did very little to change the material from which they made their tools. They used only those things they could see, and they used them in the form in which they found them. Because they did nothing to change or improve the clubs or stones which they picked up, we can say that men became tool users long before they became toolmakers.

But as time went on, the people of the Rough Stone Age began making crude tools. They learned to tie a stone to a wooden handle and make a crude hammer. They learned to select a club more carefully. For cutting tools they chose stones with smooth, sharp edges.

The tools of men living in the Rough Stone Age have been found in caves, buried under layers of shells, soils, and bones which were the waste piles of people who lived in the caves long, long ago. We are told that some of these tools were used by people living upon the earth as long ago as three

hundred thousand years. How do people know how long ago these tool users lived? There are no written records which tell us about them.

Scientists do not need written records to learn about these things. They have learned to tell about the time of events from the study of the formation of rocks. They have learned to tell the time of events from studying the traces left by the ice sheets which covered the earth for thousands of years. They have learned to tell the time of events from studying the rings of trees; the fossils of plants and animals found in mines and caves; the deposits of coal which once were forests and jungles. They have studied the buried bones of animals which once lived upon the earth, but which are no longer found. All of these things tell the scientists what happened long ago and the age of the tools which they find.

During the Smooth Stone Age men made great changes in their tools. At first they had used the flint they found lying on the ground. Later they discovered that flint which had not been exposed to the weather chipped better and made sharper tools. So they began to dig into the earth for flint, burrowing far underneath to get the flint from which they made their tools and weapons. Those tribes of men who could get flint were fortunate. They made tools for themselves. We know that they sold tools to other tribes, for tools made from flint taken from a single mine have been found scattered in places quite distant from the mines.

During the periods in which men were making stone and flint tools, they were also making tools from wood. Wood was the most common material used by the early people for several reasons. It was right at hand in various sizes and in various shapes, ready for use. The branch of a tree became a drag to carry a load. A floating log became a boat. A forked limb was useful as a plow or a hoe. As soon as men had invented the ax, they were able to cut wood into still other shapes and sizes — into slabs, into boards, into poles. They were able to cut logs crosswise and make wheels. They made handles for their flint tools from wood, and they made mallets and hammers from it. Because wood bent easily, men were able to invent the bow. Since pieces of wood could be fastened together with pegs or nails, men learned how to build a large object from smaller pieces of wood. Wood could also be carved into various shapes and forms. Every forest held an endless supply of wood that could be had for the taking.

All during the thousands of years while people were using stone and wooden tools, they were very independent. A man could own all the tools he had the time and the skill to make. During the Stone Age men had learned to raise grain for food and flax for clothing, to keep herds of animals, and to hunt and fish. They were dependent upon no one but themselves. Though men had begun to live in villages, each village made all the goods it needed and used all the goods it made.

At first, man's tools were like those at the right, roughly shaped, and without handles. They were grasped in the hand. You see in the picture a hammer, two scrapers, a cutting or chopping tool, and some piercing tools.

As civilization advanced, man's tools became like those at the right. They were much more carefully shaped, and many of them were provided with handles of wood, bone, or horn. In the picture are an ax, an axhead, a saw, a sickle blade, a dagger, and an arrowhead.

When man learned to use metals, well-shaped tools and weapons like those at the right were produced by smiths. Such tools were not only highly effective, but they were artistic in design as well. In the picture you see a sword, some axheads, a dagger, and a lance head.

Then a great change came. Men discovered metal, a new material from which to make tools. Tools of metal were much better tools than those made from stone and wood. They were sharper and stronger. Each tool could be shaped to suit the work for which it was needed. With metal tools men were able to do better work.

But metal was harder to get than either wood or stone. Most metals are imbedded in rock or hidden away beneath the surface of the ground. Copper was probably the first metal used for making tools. It was perhaps thirteen to fifteen thousand years ago that copper was first used for tools and weapons. To get supplies of copper, men had to travel long distances. They had to dig in the ground. They had to find a process for separating the copper from other materials in the ore. This was a hard process. When men were able to produce some copper, they treasured it as we treasure gold. So tools and weapons became of much greater value than ever before.

Since people had to travel to carry loads of copper from one place to another, there was need for larger boats, for stronger pack animals, and for heavier carts. The increased travel led to trade among men of different villages and different tribes. It led to the discovery of new methods of making tools and weapons. It led to new ways of living, and the new ways of living increased the need for better tools and weapons.

In time, men discovered tin, and they learned to make bronze by mixing copper and tin. It is not known definitely which of the early peoples were the first to use bronze. Since men could not find enough of either copper or tin near the surface of the ground to supply their needs, they followed the veins of copper far underneath the ground. This was the first real mining. The early miners learned to build fires under the rock veins and then throw water upon the heated rocks. The rapid cooling caused the rocks to crack and expose the metal.

The making of bronze tools and weapons required great skill. Melting the copper from the ore and mixing it with tin was a long and difficult process. Not every man could make bronze weapons and tools; only a few men had enough skill to do the work. So there grew up a class of workmen, called *smiths*, who were the toolmakers. They spent all their time in getting copper and tin from the ore, in melting these metals together to make bronze, and in fashioning tools and weapons from the bronze. The smiths worked at forges heated by charcoal fires. The tools of the smiths were much the same as those used in handling metals nowadays — the bellows, the anvil, the hammer, and the tongs.

In time, the smiths learned to use iron as well as bronze. Probably iron was first discovered along the Black Sea. The smiths became excited over the idea of having a new metal to use. But because of the difficulty in smelting this metal, the iron

industry did not grow rapidly in early times. It is only in the last few hundred years that iron has been used a great deal. Now, iron has become the most important metal we have, since it is used for making most of our wonderful tools and machines.

The Ages of Man. I. Write a paragraph about each of the periods of man's development, beginning with the Rough Stone Age. Show how each period differed from the one before it.

II. In the Rough Stone Age men used wood as well as stone. Why do you think this age was called the Rough Stone Age and not the Wood Age?

Wooden Tools. Prepare a list of the qualities of wood that make it a suitable material for making tools. Explain why wood probably was one of the first materials used for toolmaking. Have we any wooden tools today?

Stone Tools. I. Explain how men have found out what the earliest tools were like.

II. Explain the difference in the kinds of tools made in the Rough Stone Age and the Smooth Stone Age. Make a list of the tools which the people of the Rough Stone Age and the Smooth Stone Age used. Perhaps you can give the names of some that are not mentioned in this story. Explain why flint was better adapted than other stones for making weapons and tools.

III. The Indians used flint for making weapons. Describe one kind of weapon they made from flint.

Metal Tools. I. Why would you think that the use of metal for tools made people less independent?

II. Perhaps you could write a verse, showing the satisfaction that a knife maker may have had in first making a bronze knife.

III. Make a list of as many kinds of smiths as you have ever heard of, such as *blacksmith.*

Interesting Things to Read. Here is a list of books that will tell you more about man's problem in learning to use tools. Consult the Table of Contents of any of these books to find chapters or passages that tell about the tools of early man.

The Early Story of Mankind by Marion G. Clark and Wilbur F. Gordy

The Carpenter's Tool Chest by Thomas Hibben

Inventions and Discoveries of Ancient Times by William L. Nida

You may also find interesting facts about early tools in some of the books listed on page 16.

TOOLS FOR ALL PURPOSES

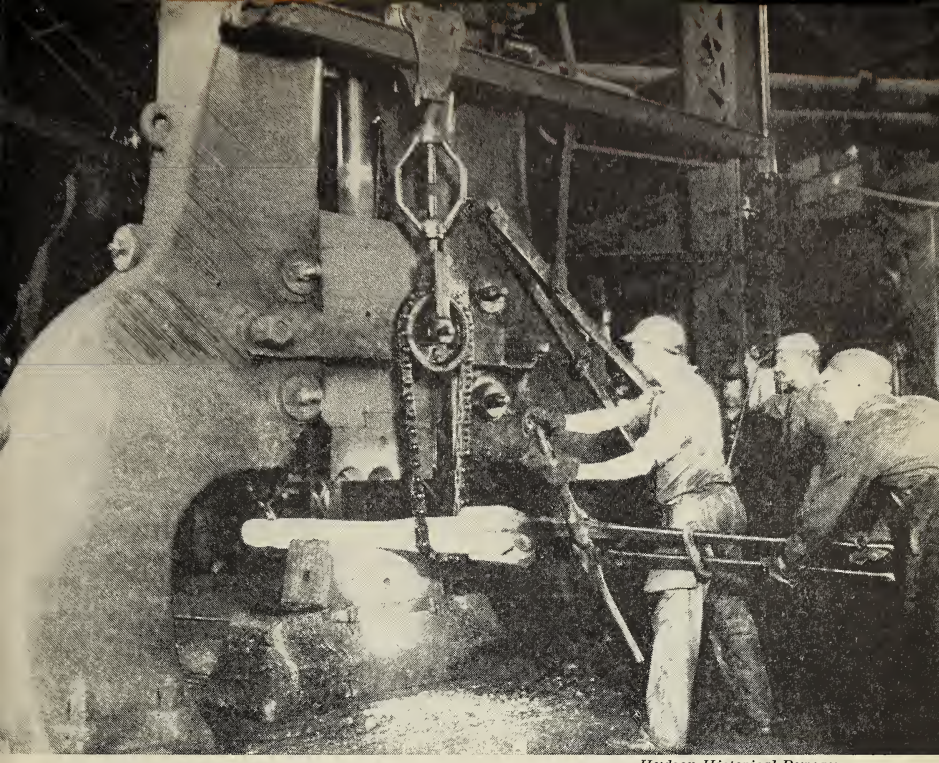
Probably the first tool used by man was one for pounding or striking — the hammer type of tool. Sometimes tools of the hammer type are called *percussion* tools. Hammers and mallets are percussion tools. The pile driver of today is a percussion tool, and so are those huge machines called *skull crackers* which are used for breaking up scrap iron in foundries. Some percussion tools are very light and delicate. Some of them weigh tons and tons.

The Bettmann Archive

Culver Service

HAND-POWERED TOOLS OF EARLY SMITHS

The percussion tools invented by primitive people were very simple. The first one was probably just a large stone held in the hand. Later, men found ways of tying the stone to a wooden stick and thus making the first real hammer. In time, someone thought of making a hole in the stone head and of poking the hammer handle through the hole. Still later, men learned to make the hammer heads from metal. Other ways of improving the hammer, which is the simplest type of percussion tool, were discovered by man as his need for better hammers was increased.



Hudson Historical Bureau

HUGE STEAM-DRIVEN HAMMERS OF MODERN SMITHS

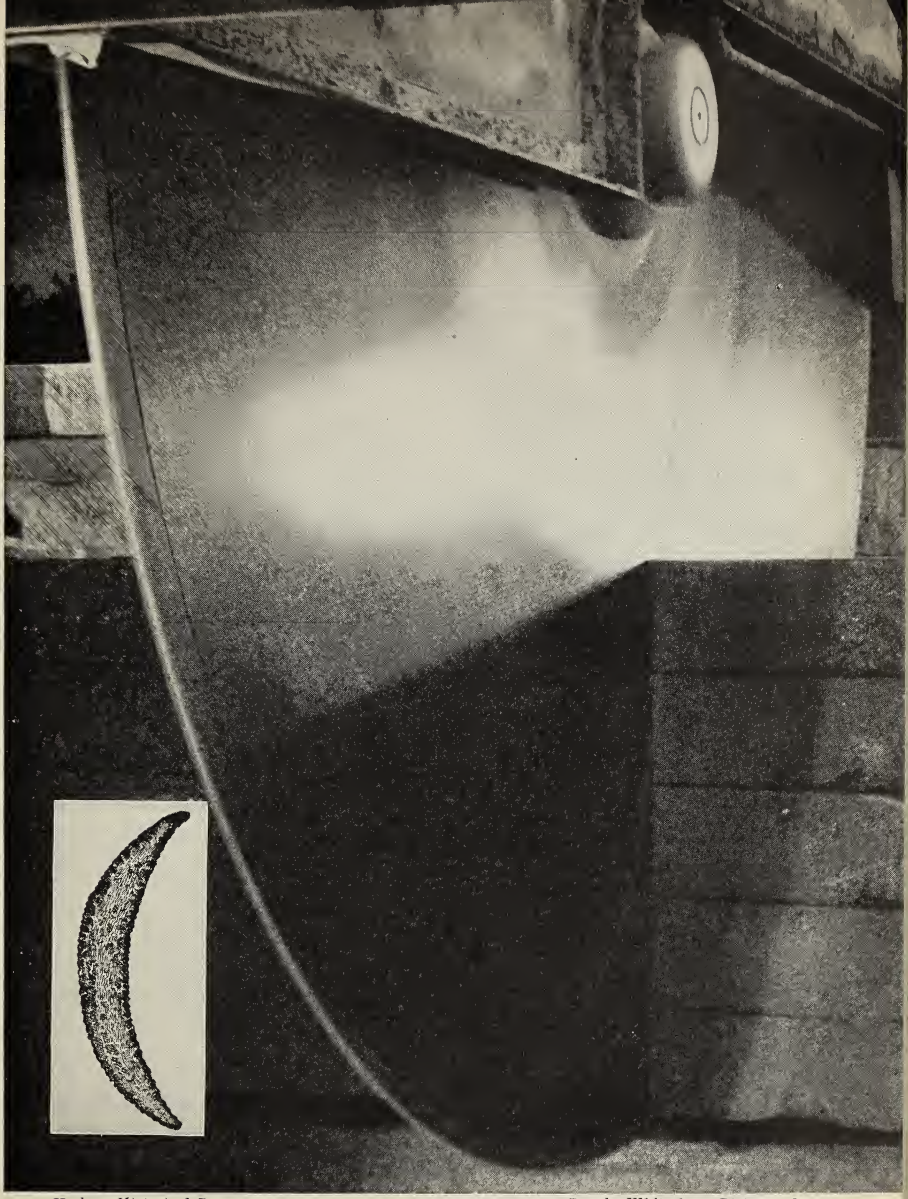
The hammer was the most important tool of the metalworker, because his chief work in the early days was to pound metal into shape. A metalworker was called a *smiter* — one who *smites,* or strikes. The name *smiter* later became *smither,* and then it became *smith.* There were coppersmiths, silversmiths, blacksmiths, and goldsmiths. Their forges belched smoke and sparks. Their anvils rang with the sound of the hammer on copper, the hammer on silver, the hammer on gold, and the hammer on iron. The smiths were important people in the building of civilization.

The first cutting tools may have been made for weapons. Primitive men were fighters. They had to fight wild animals. They had to fight other men. For this reason they needed weapons. Later, people used cutting tools as an aid in their work of getting food, clothing, and fuel and of making houses.

There are many kinds of cutting tools. Some have sharp edges for cutting or shaving. Knives, axes, adzes, chisels, shovels, planes, hoes, scrapers, plows, and shears are all cutting tools. One after another, these edged tools were invented, many of them having their beginning in very early times. The plane took the place of the simple scraper used by the very early people to smooth a rough stick or log. The hoe took the place of the primitive digging stick. The plow took the place of the forked stick.

Other cutting tools were made with sharp, strong points instead of blades. These were used for boring or for drilling holes. Perhaps the first tool of this kind was a thorn or a pointed bone. Spears, daggers, awls, augers, bits, and drills all belong to this class of cutting tools. Today there are drills which can cut through steel or granite with no help from men; and yet before men could make such wonderful drills, they had to learn to make tools with which they could drill holes by hand.

Another kind of cutting tool is the saw. The first saw was possibly a badly nicked knife. Until men had the saw, they were forced to fell trees and to cut them into useful lengths with the stone ax.



Hudson Historical Bureau *Bourke-White from Pictures, Inc.*

AN ANCIENT AND A MODERN SAW

The large, circular, power-driven saw is cutting through limestone. The small saw was a cutting tool of early Danish people.

It was a great step forward when some primitive worker used a notched stone knife as a saw. What a step has been made from that first crude saw to the huge circular saw which today slices a log or a block of stone or granite in a moment's time! Sometimes we think the inventor of the modern saw very wonderful. But we must not forget that the first invention of the saw came thousands of years before history began. Some of the very first tools were as difficult to think out and to make as any tools that have been made in modern times.

Men have always needed tools for grinding. The people of the Smooth Stone Age ground their stone tools with sand and water. They ground them until they were smooth and even. Later, the people discovered how to make grinding tools — the rasp, the file, the sandpaper, the emery board, the grindstone, and the whetstone. Today men have huge grinding machines that can polish steel until it is as smooth as satin. The pictures on page 35 show two stages of progress in the grinding of tools.

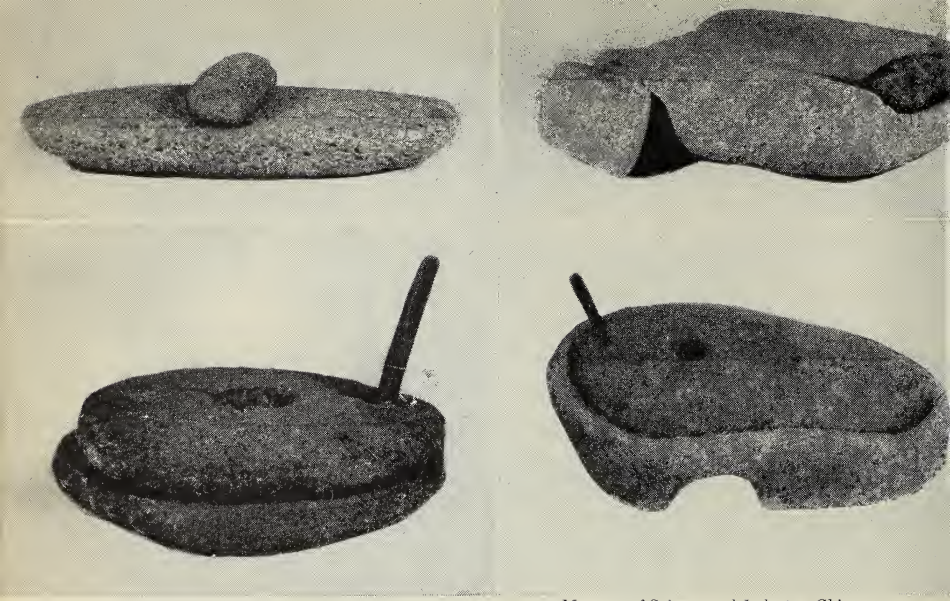
Primitive men found several good ways of grinding grain. At first they used two heavy, flat stones, moving one back and forth over the other to crush the grain. Then they invented the mortar and pestle, and later the quern. In a modern mill, flour is ground with steel rollers run by steam or electricity. The pictures on pages 36 and 37 show the early devices for grinding grains and a steel roller of today.

Hudson Historical Bureau

GRINDING TOOLS IN THE FIFTEENTH CENTURY

Ewing Galloway

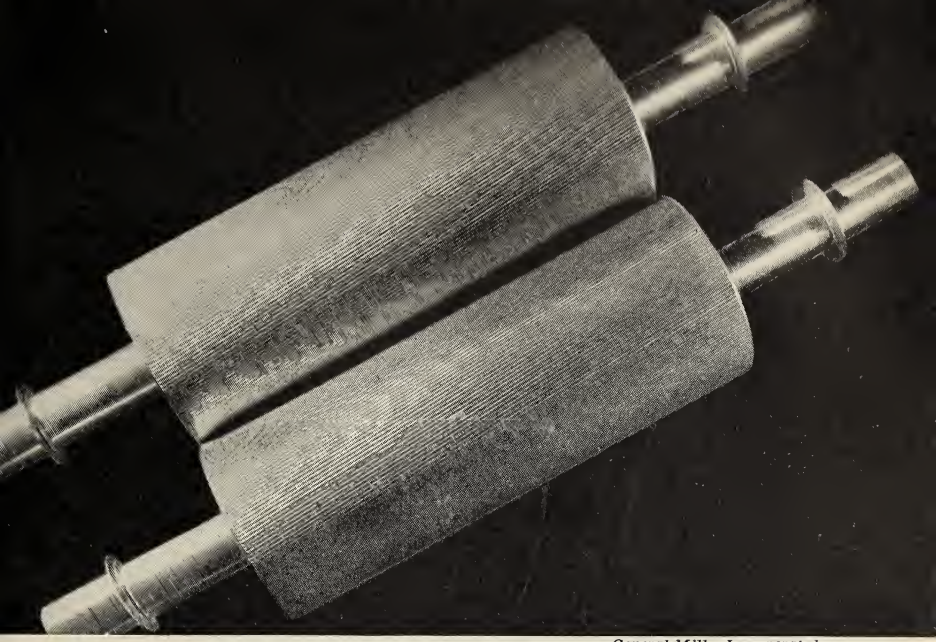
GRINDING TOOLS TODAY



Museum of Science and Industry, Chicago

PRIMITIVE QUERNS FOR GRINDING GRAINS

A fourth kind of tool which men learned to use is that for grasping and holding objects. Holding tools were not invented as early as were some of the others. Primitive men used their hands for holding objects. But as tools became better, as men became more inventive, and as more kinds of work developed, men found a need for tools which could grasp an object and hold it steady. So they invented pincers and forceps. They made tongs with which to hold hot metal. They made pliers with which to hold wire and to twist and to cut it. They made the vise to hold wood while it was being sawed or planed. Weavers learned to make a frame to hold their thread in place while they worked. Woodworkers learned to use pegs for fastening the parts of a piece

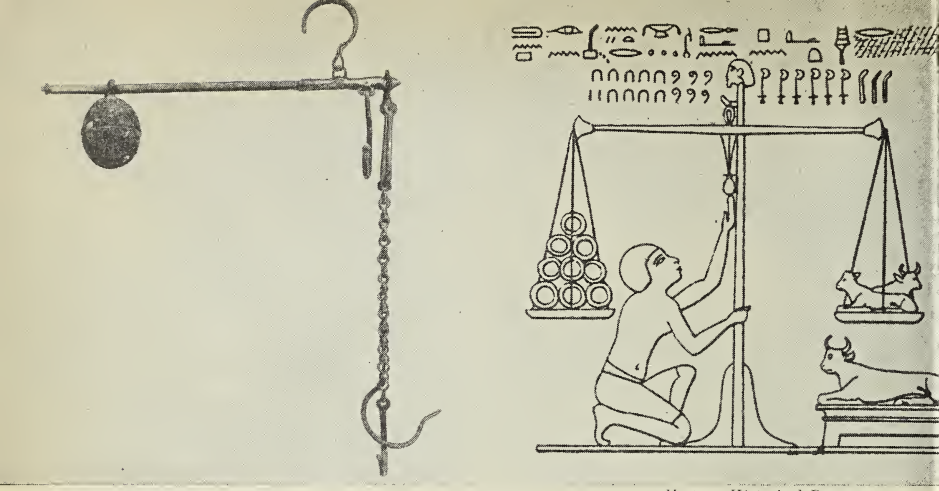


General Mills, Incorporated

MODERN STEEL ROLLERS

of furniture together; and these pegs afterwards became our nails and screws. Men learned to make cord and rope and to tie knots. They learned to make harnesses for their animals from chains, wood, rope, and leather. All these holding tools made work easier and better. Men have learned to improve these simple holding tools from time to time, with the result that we have the great frames and cranes and belts and vises which are such an important part of the machinery today.

As people were learning to use and to make better tools for cutting, pounding, grinding, and holding, they were becoming interested in measuring. "How long is this piece of board?" they asked. "How much does this metal weigh?" "How long has the



Huason Historical Bureau

EARLY MEASURING TOOLS

At the right is a sketch from an early Egyptian carving, showing how the Egyptians used a balance for weighing. At the left is a Greek scale of bronze.

sun been up?" Such questions could be heard on all sides. To answer these questions, people began to want tools for weighing and measuring. They invented the try square and the level and the compass. They made the balance and the scales for weighing. They became interested in measuring time, and they made the sundial, the water clock, the sand hourglass, and finally the watch. These instruments have grown into the perfect measuring tools which we have today. We have scales so delicate that they will weigh a human hair or the writing on a piece of paper. Think of the time it has taken mankind to learn to make measuring tools of all these different kinds!

Perhaps it was the moving of heavy objects that gave the most trouble to the early people. How

they invented ways for doing this most difficult work of all is a long story. You will read that story in the next section of this unit.

The Kinds of Tools Men Use. I. Many tools, instruments, and machines have been mentioned in the story you have just read. List them in columns to show the use of each tool: pounding, cutting, grinding, grasping or holding, and measuring. Add to the lists any other tools that you can think of.

II. Examine all the tools you can. What materials are used in making each tool?

III. In your home you use many aids for doing work. Some of them are tools, such as the hammer or the file. Some of them are instruments, such as the clock. Some of them are utensils. Some of them are apparatus, such as you use for lighting or heating. In a way, all of these aids are tools, since they help people to do their work.

Look about your house and see what household tools of these different kinds are used. Make as complete a list of them as you can. Arrange the tools according to the kind of work they do. Use these headings: (1) Tools Used in Heating Your House, (2) Tools for Cooking, (3) Tools for Sewing, (4) Tools for Amusement, (5) Tools for Lighting, (6) Tools for Ventilating, (7) Tools for Repairing, (8) Tools for Gardening, (9) Tools for Locking, (10) Tools for Measuring, (11) Tools for Writing, (12) Tools for Signaling, (13) Tools for Transporting.

IV. Have you ever made a tool for your own use? If you have, describe to the class how you made it.

V. Select one occupation you know something about. List the tools used for carrying on this occupation.

THE SIX SIMPLE MACHINES

Why was the moving or lifting of heavy objects such a problem for the early men? Why is it hard to lift a heavy object, or to move it from one place to another? It is because of two strong forces which must be overcome — *gravity* and *friction.* How do these forces act?

Gravity is the strong force which pulls an object toward the center of the earth. It is the pull of this force which makes an object heavy. Some objects, such as stones or chunks of metal, are heavier than others. That is because the pull of gravity upon such objects is stronger than it is upon feathers or paper. Gravity pulls our bodies toward the center of the earth. This pull gives them weight. When we lift an object, we have to overcome, or work against, the force of gravity.

Friction is resistance caused by rubbing one rough surface against another. It is hard to drag a block of stone over the ground. If the sides of the stone were polished smooth and the surface of the ground were smooth as glass, there would be little friction and the stone would be easier to move. But because the ordinary block of stone is rough, as well as heavy, and because the earth is rough, men find it hard to move a heavy stone over the earth without special aids. You have felt the force of friction yourself when you have tried to pull a sled over a spot where the snow has melted and the sled runners grate on the earth or cement. Moving a

heavy object over the surface of the earth is made a difficult task by the force of friction.

As groups of people improved their ways of living, they kept wanting better and finer things. They wanted beautiful buildings. To build such buildings, they needed to quarry great blocks of stone and carry them long distances. They needed to lift those great blocks of stone and pile them one upon another. One of the early buildings that you know about is the Great Pyramid, in Egypt, which is so large that it took one hundred thousand men twenty years to build it. It is built of great blocks of stone which had to be moved many miles, over water and land, to the place where the building was to stand. The Great Pyramid stands nearly five hundred feet above the ground. How did the early Egyptians build this mighty tomb? Remember that it was built more than four thousand years ago. How did they overcome the forces of gravity and friction?

Other civilizations performed mighty tasks, too. The Assyrians, the Babylonians, and the Chinese were great builders. The early Greeks and Romans built temples and baths and basilicas. Parts of these structures are still standing, and we continue to marvel at the skill of their builders. How did they build these wonderful structures?

The answer is surprising. In order to perform the heavy work of moving and lifting which these early buildings required, the people who built them

had to invent the principles of machines which are in use today. People often speak of machines as modern — as though they have been used only a short time. They seem to think that modern man is quite remarkable because he has invented the various kinds of machines with which he does the world's work. But they forget that it was ancient man who discovered the six simple machines upon which many of our machines depend. They forget that long ago man first used the six types of machines which today do much of the work of the world.

What are these types of machines? And what are the principles upon which they work?

First of all is the *lever*. A lever is a simple machine used to lift a heavy object or to apply pressure. When primitive man used a stick to pry up a heavy stone, he was using the lever principle. He did not know it, and he did not call his invention a lever. But that did not matter. When early man paddled a boat, he was using the principle of the lever. He used the same principle in lifting water from a well, and in pressing oil out of olives and the juices out of fruits. Today you may see a workman using a crowbar to lift a stone; and his crowbar is a lever, too, even though he may not call it by that name.

A lever consists of a rod or bar which rests on a fulcrum. When one end of the bar is placed under a load or weight, a man's hand pressing upon the other end of the bar can lift the load. Most of the weight of the load is borne by the fulcrum on which the bar

rests; the man bears only a part of the weight. The lever was a great help to early man in lifting heavy loads.

A seesaw is a good example of a lever. A hammer used in drawing out nails operates on the lever principle. Baseball bats and croquet mallets and nutcrackers operate on the same principle. So do can openers and scissors and pump handles and tack lifters and pliers. Practically every machine includes one or more forms of a lever.

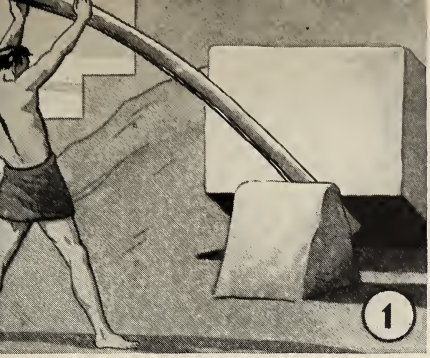
The *wedge* is another type of simple machine which was discovered in primitive times and which is used today in carrying on the work of the world. The wedge is a piece of wood or stone or metal which tapers to a thin edge. Early man used the principle of the wedge in breaking apart materials such as wood or stone. You know that the simple cutting tool of early man was a stone sharpened on one edge. The sharpened edge cut into a block of wood or stone, and the thicker part of the tool helped to pry apart the two pieces of the block. From observing how it worked, man learned to make a cut or groove in a piece of solid material, to force a wedge of stone or wood or metal into the opening, and to pound on the wedge until the block or log cracked apart. The knife and the ax of today are wedges with a sharp, cutting edge.

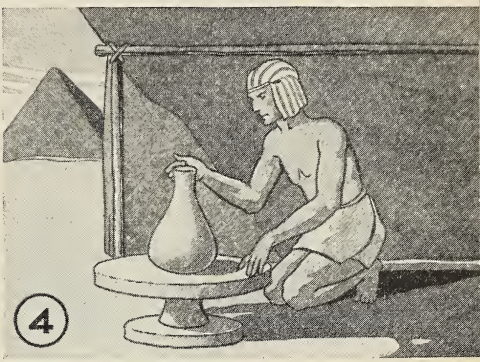
The *inclined plane* is a third type of machine which has been in use since early times. Men must have learned early that a stone or any other weight would

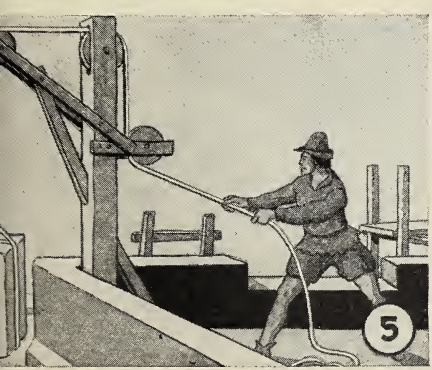
slide down a slope of its own weight; and they probably discovered quite early that it was easier to carry a load up a gentle slope of a hill than up the steep side of a cliff. The Egyptians are thought to have used the inclined plane as a means of getting huge blocks of stone to the top of the pyramids which they built. Workmen have long used skids in loading and unloading wagons or trucks or ships.

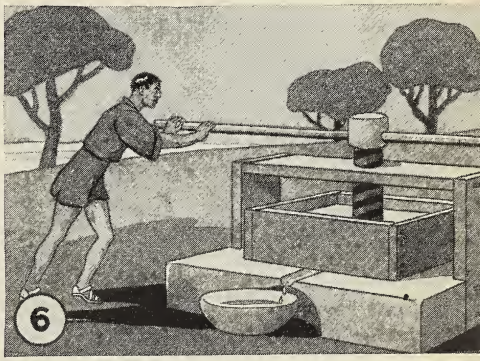
A fourth type of simple machine is the *wheel and axle*. Primitive man was slow in learning to use the wheel as a means of helping to carry on work. But long before the dawn of history men were using circular motion in the form of the potter's wheel to shape their bowls. Later, men learned to use the wheel in making a machine for shaping wood. That machine was the lathe. They also used the wheel to grind stone or metal. Still later, men learned to use the wheel for lifting weights and as an easy means of carrying heavy loads from one place to another.

Today the principle of the wheel and axle is the basis for much of the complicated machinery found in our factories. Wheels move upon wheels, cogs fitting into cogs with exactness. A circular saw which rotates rapidly will cut through a huge log with lightning speed, slicing it into even, smooth boards. Rollers crush stone into powder and wheat into fine flour. Grinding machines, polishing machines, cutting machines, moving machines, all use the principle of the wheel and axle.









1. The lever
2. The wedge
3. The inclined plane
4. The potter's wheel
5. The pulley
6. The screw

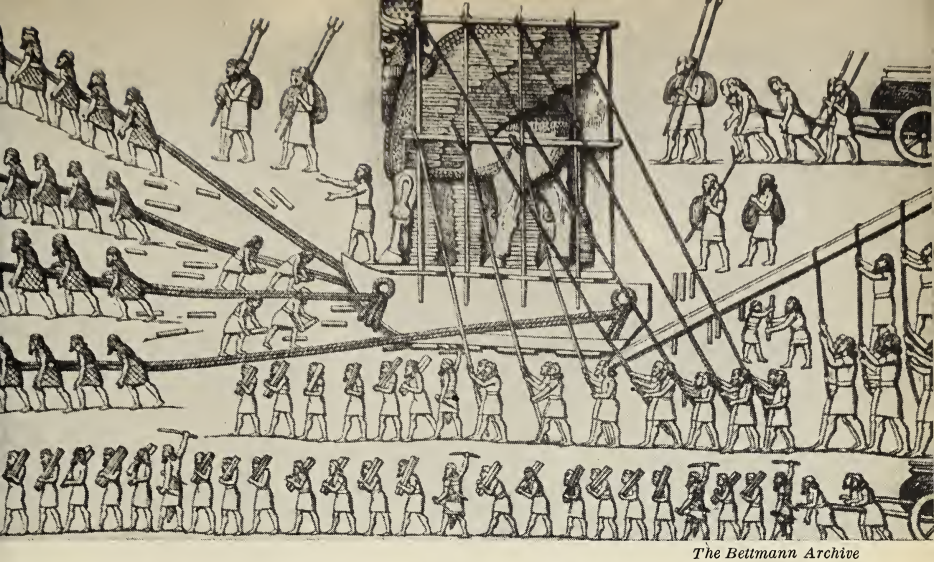
MAN'S EARLY USES OF THE SIMPLE MACHINES

Which of these machines were probably used earlier in the history of man's development? Which later? What power operates each machine?

A fifth type of simple machine is the *pulley.* A pulley is a wheel with a rope, belt, or chain moving over it. Men learned early to use the pulley for lifting heavy loads. Some elevators in which we ride today are lifted by the pulley. You may have seen loads of brick carried to the tops of buildings by means of a pulley. The pulley is used in the huge cranes that load cattle and horses on boats. The pulley has been used since early times, and yet men have never ceased to find new uses for this type of machine. Nor have they ceased to find new forms in which the pulley can be made.

The sixth type of machine is called the *screw.* The principle of the screw is thought to have first been used by the Egyptians to raise water from a lower to a higher level. Later, the screw was used for pressing olives and in a machine for pressing cloth. The early printing press used the screw to press the type against the paper. In time, the screw came to be used in many kinds of machines that lift heavy weights, and in machines that are used to grind materials into small particles. The water faucet and the food grinder in our kitchens use the screw. Delicate instruments like our microscopes use the screw to raise and lower the lenses.

The pictures on page 45 show six ways in which the simple machines were set to work for man. As you study each machine, try to think of other ways in which that machine was used in early times, and of ways in which it is used today.

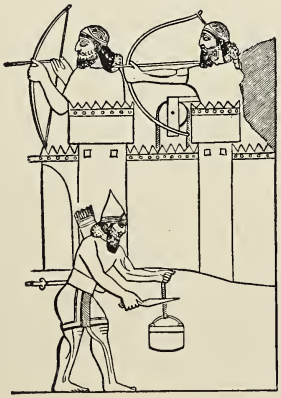


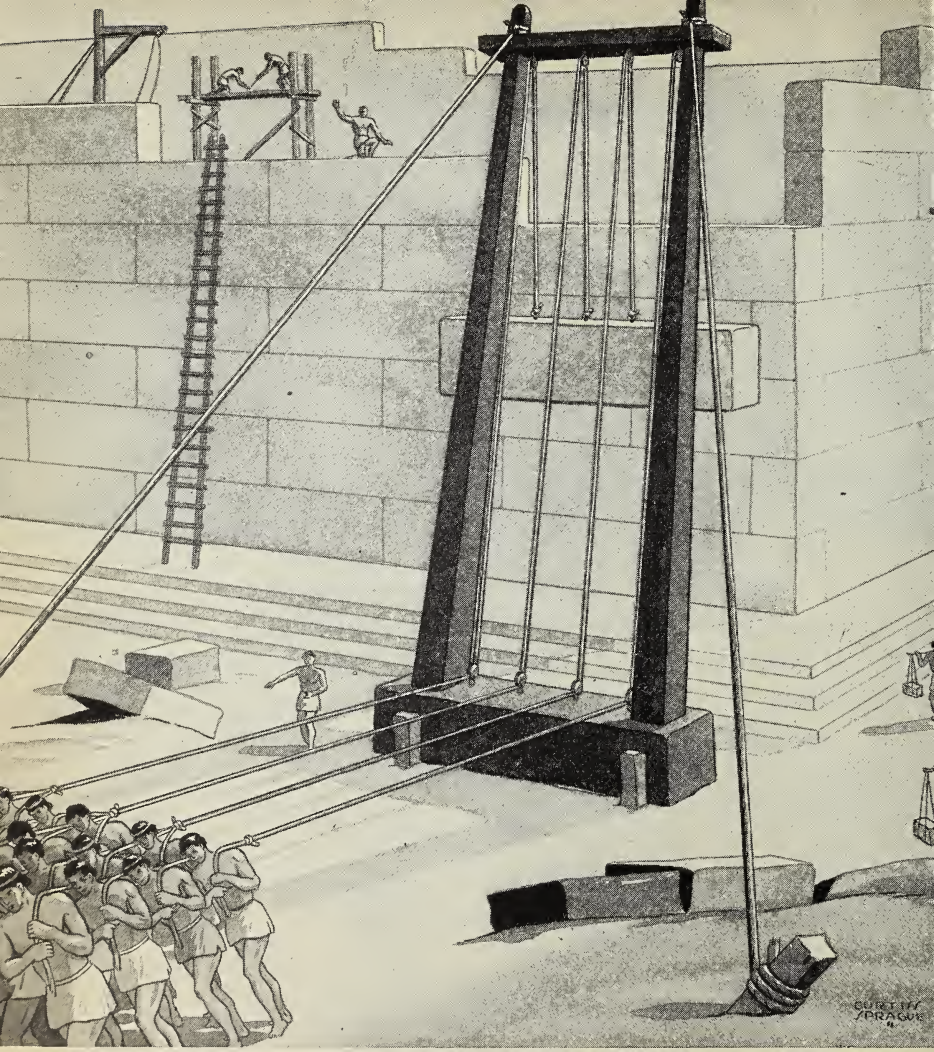
The Bettmann Archive

RECORDS IN STONE

Ancient carvings in stone are our only records of how men used the simple machines. Above is a copy of a carving from ancient Assyria. Can you find in it a record of how men used a lever? A wheel? What are the different groups of men doing?

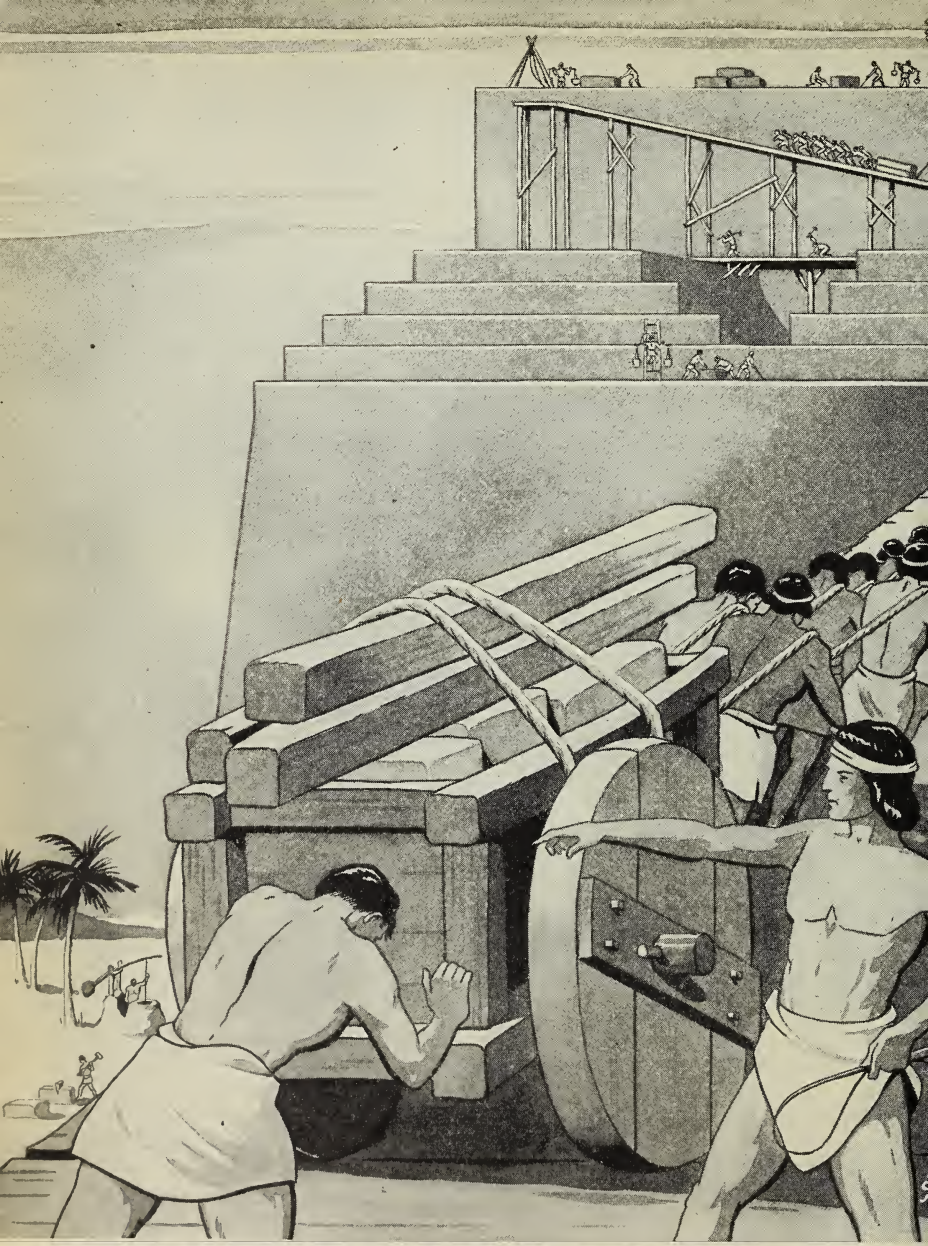
The lower picture is a copy of another ancient carving from Assyria. It shows the use of the pulley in warfare. Do you see the pulley? The man in the lower part of the carving is really behind the wall; but the artists wanted him to show. What do you think he is doing?





AS IT MIGHT HAVE BEEN

This picture shows how earlier men may have used one of the simple machines to erect a mighty structure. The picture is imagined, because people of modern times often have to guess at some of the ways in which earlier peoples worked. What simple machine can you find in use in the picture? Contrast this means of lifting a heavy stone with the ease with which our modern crane does such work.



BUILDERS OF EARLY TIMES

Can you find the principle of each of five simple machines in use in this picture?

Men used these simple machines at first without realizing their great possibilities. They knew only that they had found easier ways to do their work. Modern men have come to understand much more about how these simple machines operate. For this reason, they can make more efficient and more complicated machines. They have learned to adapt their machines to many uses. They have learned to replace much of man's drudgery with the machine.

Learning about the Simple Machines. I. Find pictures which illustrate the simple machines. You may find them in a science text from the high school. You may also find them in *Webster's Unabridged Dictionary.*

II. Make a chart to show some of the different uses of the six simple machines. Allow for six columns, and at the top of each column put the name of the machine. List the ways in which each machine is used.

III. Make a model of one of the simple machines. Be able to explain to the class how the machine works.

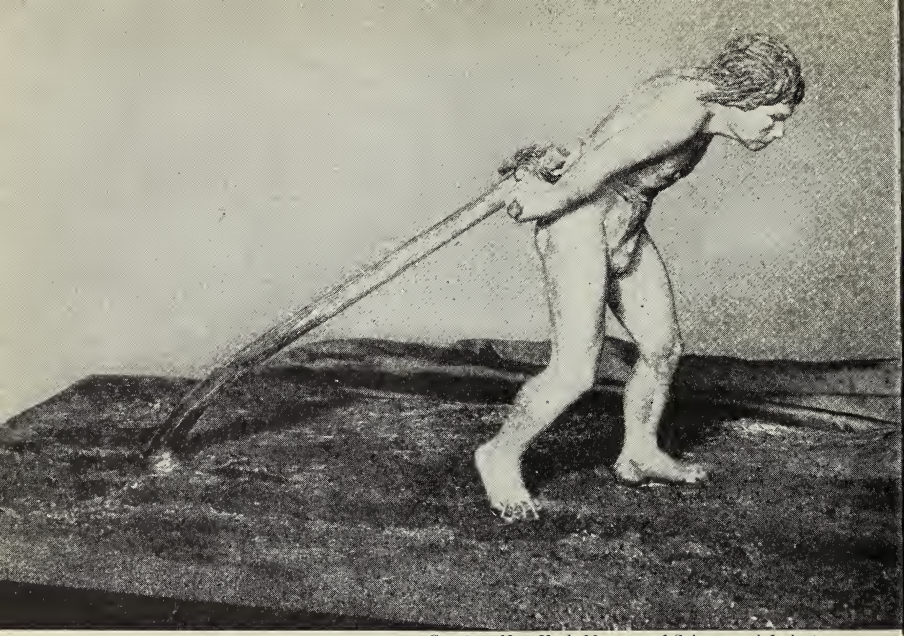
The Forces That Make Work Hard. I. Mention some kinds of tools or machines we use today for overcoming gravity. Make a list of some ways in which we use the pull of gravity to help us.

II. Mention some of the ways that we have today of overcoming friction. Mention some ways in which we use friction to help us.

Reading about Simple Machines. Look through the books listed on page 16 for facts about simple machines.

Credit note: The picture on page 49 was furnished by Bourke-White, from Pictures, Inc.

LIBRARY OF THE UNIVERSITY OF ALBERTA



Courtesy New York Museum of Science and Industry

PLOWING BY THE POWER OF MAN'S MUSCLE

THE SLAVES OF EARLY MAN

For a long, long time, man depended upon his own muscles to do all his work for him. His strong hands grasped his crude tools, and his powerful arms wielded them. His legs were his only means of travel, and his back carried all his burdens. But man often grew tired of such heavy use of his muscles. His hands grew sore and his arms ached. His back bent and his legs faltered. Surely man needed help to do the necessary work of the world.

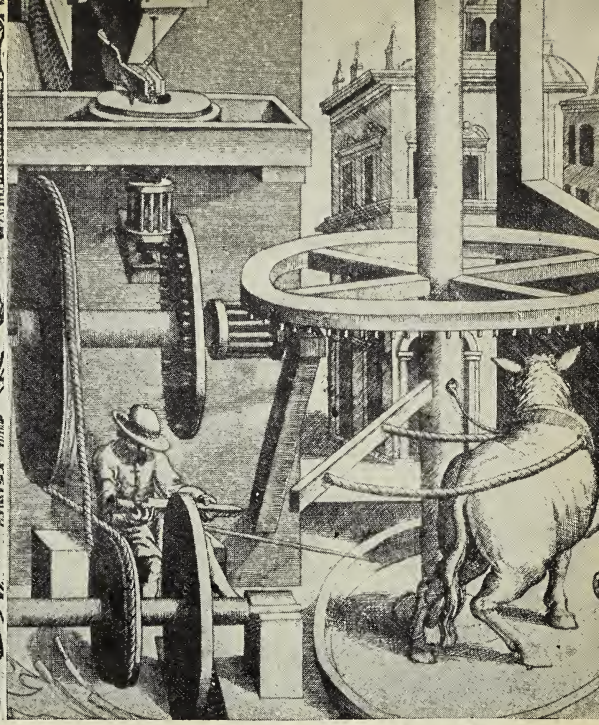
After man had tamed some of the animals, he taught them to help with his work. The animals had strong muscles and sturdy backs. Man found that the ox and the elephant were powerful; that

Courtesy New York Museum of Science and Industry

ANIMAL POWER PULLING THE PLOW

the horse was fleet; that the camel was an excellent traveler; and that the donkey was both sure-footed and patient. One by one, man added more animals to his list of workers. The ox, the horse, and even the dog were harnessed to the plow, the drag, the sledge, and later the crude cart. The horse and the ox were often put to work turning the windlass, which was used to lift water from wells or rivers, or to turn the wheels of crude mills. The camel, the horse, and the elephant were good travelers and burden bearers. As man learned to use animals for travel, roads and bridges were built. So for a great many years *animal power* was man's chief help in doing the work of the world.

The Bettmann Archive



Hudson Historical Bureau

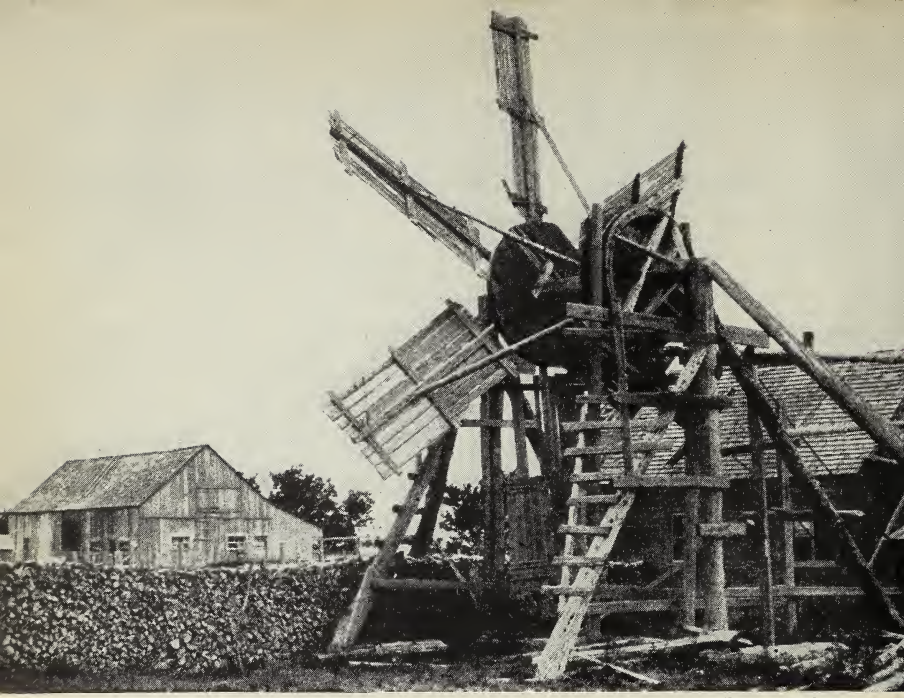
EARLY TREADMILLS

Human power turns the treadmill at the left, while animal power turns the one at the right. Can you tell what work is being done in each picture?

As centuries rolled by, the number of people living upon the earth grew larger. The more powerful groups conquered the weaker ones. The captives in warfare were taken into slavery. The slaves were put to work for the conquerors. Some of the slaves were put into stone quarries and forced to lift heavy stones until they were unable to work longer. Some of them toiled on the farms of the nobles or strained at the oars of great ships. They were put to work at some of the tasks that animals did — turning windlasses or treadmills and carrying back-breaking burdens. Down through the centuries human slaves sweated and strained while their conquerors threatened and abused them, trying to get the work of the world done. Indeed, during those days of fighting much of man's work was shifted from the muscles of the conquerors to those of the conquered. *Human power* helped to perform the work of the world.

Later, man found a new source of power. He saw the wind push against the trees, against the surface of the water, against clothing. He felt the pressure of the wind against his own body as he walked. He watched the fury of great storms and the power of the wind to blow down trees and move objects.

"Wind is a mighty force," man said. "It can be made to do work just as our beasts and our captives have been. The wind can be made a third slave to help with the world's work." So man learned about *wind power*. He made sails for his



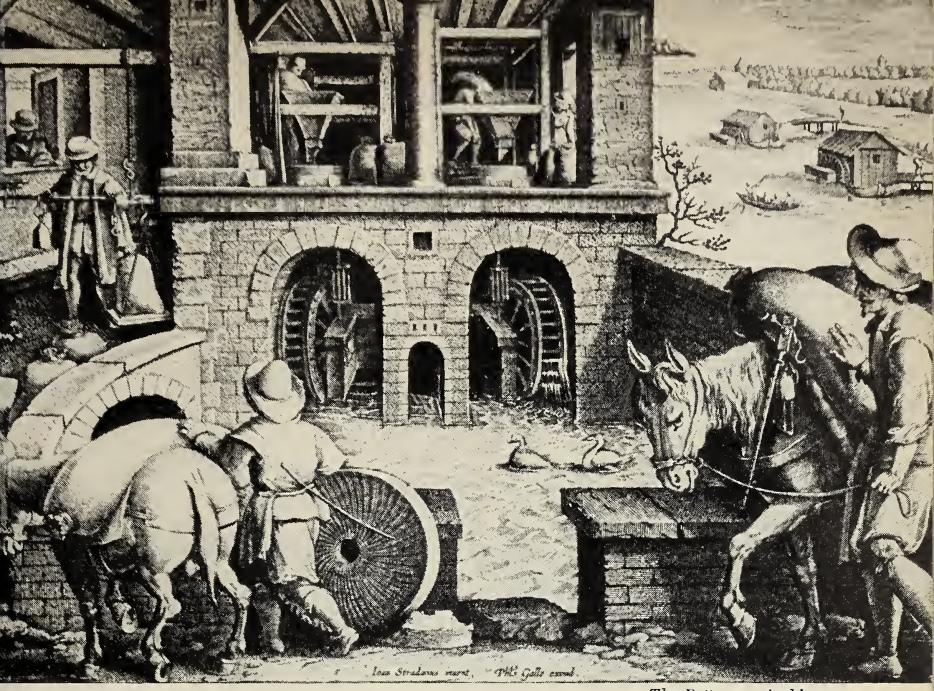
Philip D. Gendreau

WIND POWER

This primitive sawmill in Canada suggests how earlier men may have harnessed wind power to do work.

boats, and the wind pushed against the sails and moved the boats. He made windmills to turn millstones and pump water. Wind became one of man's best slaves.

Man saw the swift currents of streams send logs scurrying along. He saw that falling water will wear away the banks of rivers. He saw floods sweep houses and trees before the mighty strength of the water. Then man harnessed the water and made it work for him, just as he had forced other slaves to work for him. He made rafts and boats that were carried along by the currents of streams.



The Bettmann Archive

WATER POWER

Water wheels furnish the power to operate this sixteenth-century grain mill.

He made water wheels which turned millstones and ground grain into flour. Finally, he learned how to make falling water turn the wheels of the factories which spun yarn, wove cloth, and cut logs into lumber. *Water power* became man's fourth slave.

With his tools and simple machines, and with four kinds of slaves to operate his machines, man had accomplished wonderful things in those early years of civilization. Four thousand years ago the people of Egypt had invented many of the kinds of hand tools which we use today. They knew how to mine ore and smelt it. They knew how to make wire, to

cast metal in molds, to shape metal into tools. They made good ships; they knew how to irrigate the land; they made dikes and canals; and they were excellent farmers. They made beautiful dishes of earthenware and of glass. They polished precious stones and made jewelry of gold and silver. They spun delicate threads of linen and wove beautiful cloth. They quarried stone in huge blocks. They moved these stones hundreds of miles and made immense buildings.

Groups of people living in other places and in other times did these things, too. The people living in the valley of the Tigris-Euphrates rivers had built up a civilization quite as good as that of the Egyptians. Later the Greeks, in their turn, built wonderful cities, and still later the Romans conquered the world of their time. The Romans built great cities, made roads and bridges, and spread their civilization far and wide. In central and northern Europe, during the period which we know as the Middle Ages, peoples of various countries improved their tools and machines. Their craftsmanship was the foundation of our modern age of industry, and their great cathedrals and cities, which still stand, prove their contribution to the improvement of tools and machines and of the use of power. All these things were done by means of tools and machines which had been invented through the ages and by means of the four kinds of power which men knew — animal power, human power, wind power, and water power.

The Use of Slaves in Ancient Times. Find out, in a history or in an encyclopedia, more about the use of slaves in ancient times. Under what key words will you look to find your material?

The Use of Animal Power. I. Make a list of animals that are used for labor today. Opposite the name of each animal listed, write the kinds of work which the animal is capable of doing.

II. Choose one animal and explain how that animal is trained to work.

The Use of Water Power. I. Find out how grain was ground in colonial times in our own country and what kind of power was used.

II. How did water wheels make it possible to use water power? Could you make a model of a water wheel? Be sure that it will work.

III. The use of water wheels is a good illustration of the use of the pull of gravity. Explain why.

The Use of Wind Power. I. Tell a story which you think might explain the discovery that wind has power.

II. Explain how windmills work. What kinds of work do they do?

Skyscrapers and Ancient Buildings. You have probably seen a tall city skyscraper. Perhaps you have even watched while one was being built. At least you know that men of today do not build skyscrapers in the same way that ancient men built pyramids and temples. Look at the pictures on pages 45, 47, 48, and 50. Then look at the pictures on pages 49 and 107. What are some of the important differences between building in ancient times and building today?

III. NEW MACHINES AND NEW POWER

Each new tool or machine that man invented and each new power that he learned to harness for his use came as a result of a deeply felt want on the part of people who had difficult work to do. In this story you will read how man discovered a new power. Would you like to know what happened to make man want a new power and how he came to discover it?

A CHANGING WORLD

For thousands of years after civilization had begun, many men were probably quite satisfied with the tools and machines they had learned to make. During those thousands of years civilization had spread over much of southern Asia and around the Mediterranean Sea in Europe and Africa. Yet through all these years of progress, through all the labor of erecting magnificent buildings and of constructing great roads, people still used the tools and simple machines about which you have been reading. And they still depended upon four kinds of power — human power, animal power, wind power, and water power.

When the Roman Empire lost its power, the groups of people who had once been under the control of Rome were left to shift for themselves. In the

British Isles and in central and northern Europe, each separate group of people took up its own life and developed its own way of living. And so there came to be the separate nations as we know them in Europe today — France and Germany and England and the others. These national groups carried on the progress of the earlier world. Each group set up its own government, built towns, made many of the things which its people needed, and carried on trade with the other groups. Like the people who had lived in the centuries before them, they did their daily tasks — raising food, weaving cloth, building houses and furniture, making tools and utensils, making pottery and ornaments, making bricks and tiles, carving stone, building huge temples and palaces, and building ships. In all their work they still used the four kinds of power the earlier people had used. Some of their tools and machines were a little better than the earlier tools and machines. But they were operated by the same power — human power, animal power, wind power, and water power.

But, in time, the people of Europe became dissatisfied with the tools and simple machines which had been in use for centuries. The population of Europe was growing rapidly. In each country more food, more clothing, and more houses were needed. Cities were springing up. The more people there were, the more wants they had and the more work it took to supply those wants.

There was another reason why men felt the need for new ways of working. There were not so many human slaves in the European countries as there had been in the earlier civilizations of Egypt, of India, of China, of Greece, and of Rome. There were no armies of captives to be placed in mines and quarries. The men and women of the newer European countries had to do much of their own work. This made them know what hard work was. It made them realize how terrible a life of slavery is. It made them want better means for pulling and lifting and straining at great loads. Ideas about work were changing.

The people found, too, that wind and water were not dependable slaves. When the wind did not blow, the work had to stop because of the lack of power. Often there was no waterfall at the place where a man needed power. Indeed, people were feeling less and less satisfied with the means they had for performing their work.

The people of Europe were beginning to travel more, too. This made them want new things, better things. They wanted all the good things the people of the East had, as well as the good things they had themselves. We say their *standard of living* was getting higher. Whenever people want more and better things, they usually try to find ways of producing them.

Men have always been inventive creatures. When they have felt strongly the need for new tools and

machines, they have been able to invent them. The tools which men have used have not been made by chance. Each one has been made because of some real need of the people who invented it.

The next story will tell how the people of Europe learned to improve their tools and machines and how they found new power to operate them.

Changes in Europe. I. Color an outline map of the world to show the more highly civilized portions of the earth in the sixteenth century. By looking in some histories, you may find the necessary information.

II. This story says that European people had come to travel more. Find out why this was true. Here are some key words that will help you to find your material: *Middle Ages, Crusades, Feudalism, Chivalry, Marco Polo, Spices, China, India.*

III. Explain why slaves were not used so much in the Middle Ages as they had been formerly.

IV. Explain why the people of Europe had become dissatisfied with the means they had for working. What kinds of tools and machines did they have? And what kinds of power did they use?

Finding New Ways of Working. I. Write an imaginary story about one of the following, telling how it may have been invented: (1) the lock and key, (2) the glass window, (3) the chimney, (4) the wheel, (5) the pulley, (6) the bow and arrow.

II. Find out how the Egyptians raised water from the Nile River to irrigate their land. Compare their method with our methods of irrigating land today.

THE FIRST FACTORIES

It would be difficult to tell the whole story of how people the world over learned to make and use better tools and machines. Each country has its own story. But this story of England's search for new and better ways of working will help you to know how the change came about in other countries.

The need for better tools and machines was especially felt with regard to the production of clothing. English weavers could not make cloth enough to clothe everyone in England well. Such numbers of people to be clothed! People needed shoes. They needed hats. They needed stockings. But, most of all, they needed yards and yards of cloth from which to make coats, tunics, trousers, and dresses.

It is true that this difficulty was not a new one. Nor was it felt only in England. There had never been enough clothing for the people of the world. Wool and flax were scarce, and cotton was not widely used. Every inch of thread, except that which was spun by the silkworm, was spun by hand, and for centuries the only tools which could be used for spinning thread were the distaff and the spindle.

Between the fourteenth and sixteenth centuries the spinning wheel began to take the place of the distaff and the spindle. But it took the work of ten spinners and ten spinning wheels to make thread enough to run the loom of one weaver. Each spinner worked in his own home. He carried the thread he spun to a weaver and sold it to him.

Hudson Historical Bureau

SPINNING AND WEAVING IN THE HOME

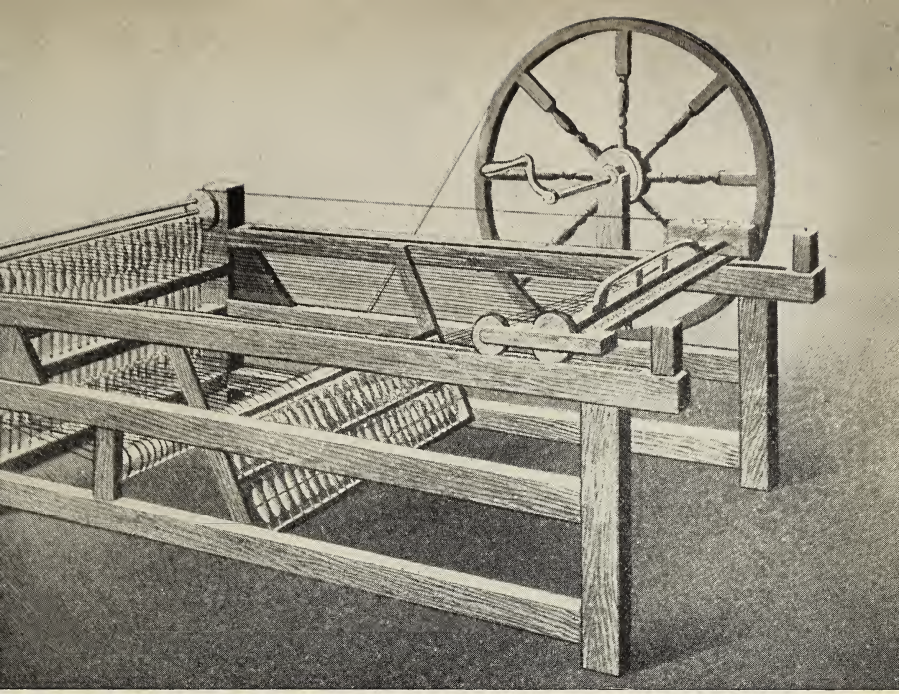
Often the whole process of making cloth was done within one family. The picture presents a common scene in the days before the beginning of the factory. What is each worker doing?

Weaving was slow work, too. Each weaver worked in his own home. In and out went the shuttle, tightly grasped in the hand of the weaver. Inch by inch the cloth grew longer. Inches grew slowly into yards, and yards grew into bolts of cloth. It took hours and hours to make one bolt of cloth. No wonder it was difficult to get enough clothing for the growing population!

The slow process of spinning thread was the chief difficulty in producing cloth. The spinners could not make thread fast enough for the looms. The weavers became impatient. "Give us more thread!" they told the spinners. "Our looms stand idle. We could do much more work if we had more thread."

And the spinners cried, "Time! Time! If only we had more time!" They rose in the morning before dawn to begin their work. They worked all day, never letting their spinning wheels stand idle. They went to bed at night only when they could see to work no longer. Sometimes all the members of a family except the small children who could not run a spinning wheel spun all day. But still the looms could not be kept busy.

Then matters became still worse, for the loom was improved until it took twenty spinners to supply the thread for one loom. John Kay, an English weaver who lived about two hundred years ago, made the first improvement in the loom. Weavers had always moved the shuttle by hand. John Kay invented a way of moving the shuttle quickly across the frame



Philip D. Gendreau

HARGREAVES'S SPINNING JENNY

by a jerk of the string. This invention made it possible for a weaver to work twice as fast as he had done before. But where was he to get twice as much thread?

For years people wished for better spinning wheels. One small improvement was made by which the fibers were stretched by using rollers. This saved a little time for the spinner. But a quarter of a century went by before men were able to find really good ways of improving the spinning wheel. Finally an Englishman named James Hargreaves, who was both a weaver and a spinner, discovered a way of improving the spinning process.

"There is no point in spinning only one thread at a time," Hargreaves told his wife. "I will make a spinning wheel, operated by one spinner, which can spin eight threads at the same time."

Hargreaves completed his *spinning jenny*, as he called his new invention, in 1767. It was a spinning wheel having eight spindles. Later he improved it so that one spinner was able to spin thirty threads.

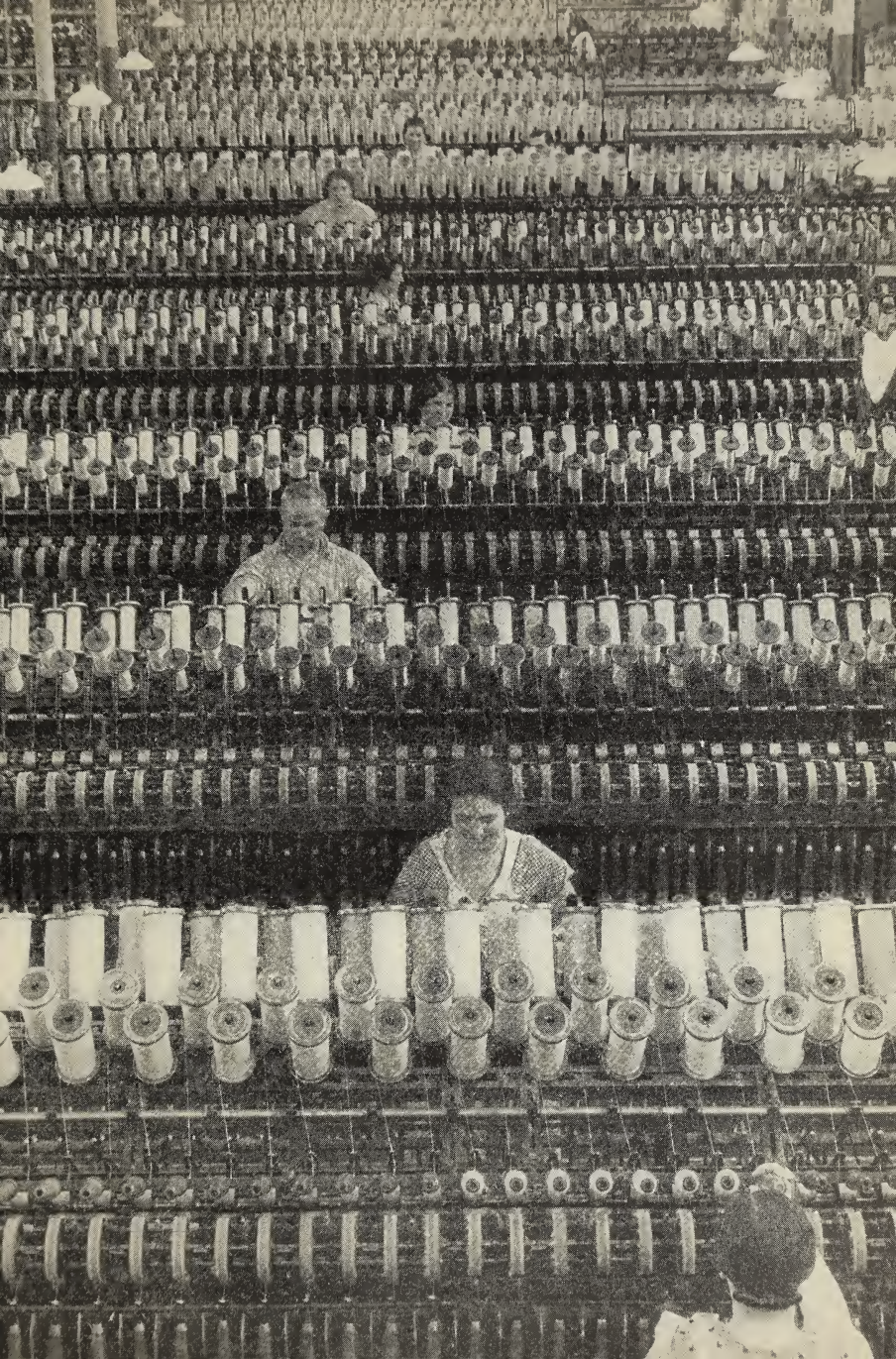
The weavers were pleased with Hargreaves's spinning jenny. They believed that it would make thread cheaper and that the spinners now would be able to make thread enough to keep their looms busy.

But the spinners were angry. They were afraid to have the spinning jenny take the place of the simple spinning wheel.

"We do not want this newfangled machine which lets one spinner and his machine take the place of eight spinners," they cried. "It will put some of us out of work. A man who will make such a machine is a traitor to his fellow workers!" And some of the spinners burst into Hargreaves's house and smashed his spinning jenny. He had to flee for his life.

But the spinning jenny had come to stay. In a few years there was one which had as many as eighty spindles. At the present time a spinning jenny in a great textile plant may have over a thousand spindles. The picture on the opposite page shows a modern spinning room.

Credit note: The picture on page 69 was furnished by Bourke-White from Pictures, Inc.

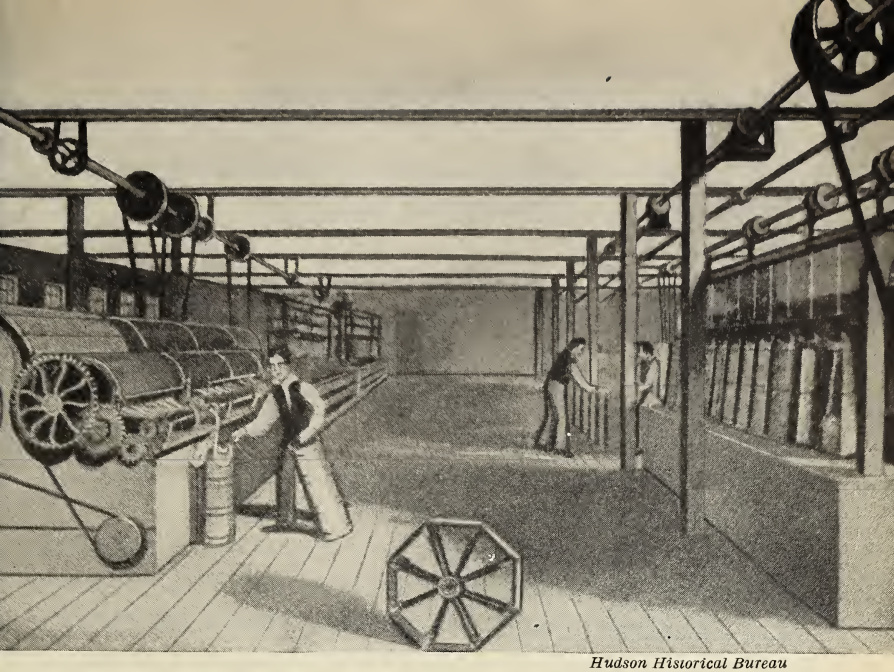


About this same time, an Englishman named Richard Arkwright made a spinning machine run by water power. The use of water power instead of man power changed the whole process of spinning. The spinners could no longer work in their homes. Factories had to be built at places where waterfalls could furnish the power to turn the spindles, and the spinners had to go to the factories. Some spinners, of course, continued to work at their spinning wheels at home. In time, however, hand spinners had to give up spinning altogether, for later improvements in the spinning machines made spinning by hand too slow to be profitable.

All of these improvements in spinning now made it impossible for weavers to keep pace with the production of thread. Then men began to improve the looms, too. In 1787 Edmund Cartwright invented a loom that could be run by water power. Other people improved Cartwright's power loom until finally the process of weaving was also taken out of the homes and placed in factories, where weaving machines were run by water power. The years during which these improvements were being made were troubled ones for the spinners and weavers.

"The machines will ruin us," said the spinners. "Soon we will have no work to do."

The spinners tried over and over again to save their hand tools by destroying the machines. The weavers, too, began to dislike the inventions.



Hudson Historical Bureau

AN EARLY ENGLISH FACTORY

"If the weaving is done in factories," they cried, "many of us cannot earn our living. We do not want the machines."

Finally spinners and weavers could fight the machines no longer. Many factories were built, some for spinning thread and some for weaving cloth. Spindles driven by water power turned round and round, winding miles and miles of thread. Power-driven shuttles darted back and forth, weaving yards and yards of cloth. The factory had come to stay.

So you can see how the people of England made power-run machines by improving their hand tools. One improvement called for another. First the loom was improved, and that improvement called

for better spinning wheels. Then the spinning wheels were improved, and that improvement called for better looms.

In this whole story of inventions, we learn the names of only a few men. But the improvements by which the hand tools of the spinners and weavers became power-run machines were the work of many people. It was through their work of improving tools and machines and building power machines that the *factory system* started in England.

The factory system was a new way of doing the work of the world. It took the workers out of their homes and put them to work in factories. Later the factory system spread to other nations of Europe. It spread to the continent of America. It is fast spreading over the entire earth. Wherever it has spread, the use of power to run machines has greatly changed the life and work of people.

Making Clothing in Colonial Times. I. How did the people of America, in colonial times, spin thread and weave cloth? What tools and machines did they use and how did they use them?

II. How did the people, in colonial times, get their tools and machines for weaving and spinning? Did they buy them? Did they make them themselves?

Wonderful Inventions. I. Make a list of the most important inventors of tools and machines for the making of cloth. Choose one of these inventors. Find interesting facts about him and his invention and report what you find to your class.

II. Why did so many of these inventions come at about the same time? Explain how one improvement in the clothing machines brought about other inventions.

Fibers. I. What fibers were used for making cloth in England before the factory system started? See whether you can find out.

II. Raising cotton and making cotton cloth became very important during the last part of the eighteenth and the first part of the nineteenth centuries. Why?

III. Eli Whitney did much to make cotton clothing more plentiful. Explain what he did.

IV. Of what is linen made? Where is this fiber grown? Where are the chief linen manufacturing centers?

Machines and the Workers. I. Write a paragraph explaining why the spinners and weavers objected to the improvements in their tools. Do you think they were right or wrong in this matter? Why?

II. What power was used for the new factories?

III. Think of how the worker lived before the factory system started. Then think of his ways of living, working, and thinking after the factory system started. Make a list of the changes that came to the worker when he changed from a homeworker to a factory worker.

THE FIRST USE OF STEAM POWER

People continued to strive for better ways of working. All this striving led to the discovery of man's fifth slave — *mechanical power.*

When the factory system started, more iron was needed for making improved tools and machines.

Iron could not be smelted without hot fires. At first charcoal was used to make such fires. Charcoal was made by burning wood in huge pits. And since charcoal was needed in such great quantities to smelt iron, the beautiful forests of England began to disappear rapidly.

By the end of the seventeenth century wood had become so scarce that Parliament made laws against the destruction of the forests to produce fuel. "If we are not careful," a speaker pointed out, "we will soon have no forests from which to make lumber for our ships. Then what shall we do? England cannot live without ships, for our navy is our only means of protection."

So the iron smelters had to find other fuel. What could they find? They began to use coal. The coal mines of England had not been worked very much up to this time, but now they became very active. New mines were opened up. Old mines were dug deeper. The development of the coal mines became an important matter.

But the coal miners also had their troubles. As the miners dug deeper and deeper, water began to seep into their pits. Sometimes miners had to stand in water up to their knees. Sometimes the mines became so flooded that men could not work in them at all. The flooding of the mines seriously delayed the production of coal.

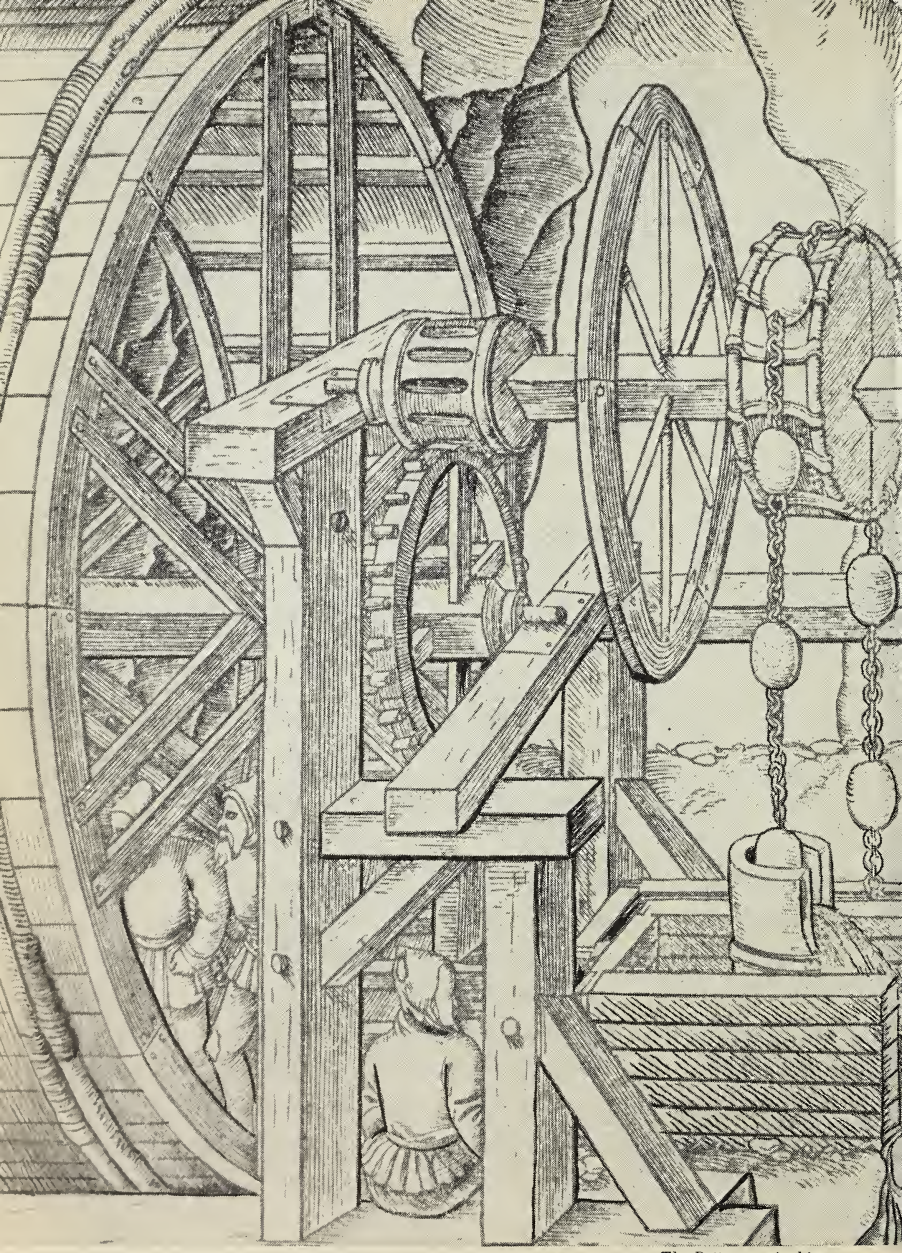
The mineowners tried to have water pumped out of the mines by pumps operated by treadmills. A

The Bettmann Archive

CHARCOAL PITS IN ENGLAND

In England in the eighteenth century, charcoal burners and their pits were necessary to the production of iron.

treadmill pump is good as long as it runs. But when the men or animals operating a treadmill stop walking, the pump stops pumping. Many mineowners placed these treadmill pumps in the lowest part of the mine where the water was deepest. Do you know why they did this? It was to make the treaders keep on working without rest. The treaders knew that if they stopped treading for very long, the water would rise and they would be drowned. It was only by constant treading that the flood of water could be kept from rising.



The Bettmann Archive

A TREADMILL IN AN EARLY MINE

Notice the men inside the large wheel. They must tread constantly to keep the wheel turning.

What England needed at this time, more than anything else, was a pump which could empty the mines rapidly; a pump which could work by day and night and never become tired; a pump which was cheap to buy and cheap to run. It was not only in England that such a pump was needed. All over the world, wherever men worked in mines, people wanted some better way of pumping out the water.

Hero of Alexandria, a man who lived nearly two thousand years ago, had often wondered about steam. He began to experiment with steam, and he found that it had force — that it could press against an object and move it. This made him realize that steam could do work. Hero heated water in a globe and made the steam pass through a small opening at the top. The force of the steam coming from this opening was strong enough to keep a small ball dancing in the air. But Hero's contrivance was only a toy. Nothing came of it. The people of Hero's time were not interested in having engines to do their work.

Today we have engines of many kinds. We have steam engines and gas engines and electric generators. We have engines to operate tools and machines in our factories. We have engines to move our trains and our boats and our automobiles. We have engines to pump water, to make electricity, and to heat our houses. We depend upon engines and dynamos for doing all kinds of work. We have had

them only a short time, however. As short a time as three hundred years ago, men did not have a single engine to help them do their work. They did not even know that steam could work, for they had forgotten about Hero's little toy engine. Men remembered it later, however, when they were wishing for some good way of pumping water from the mines in England.

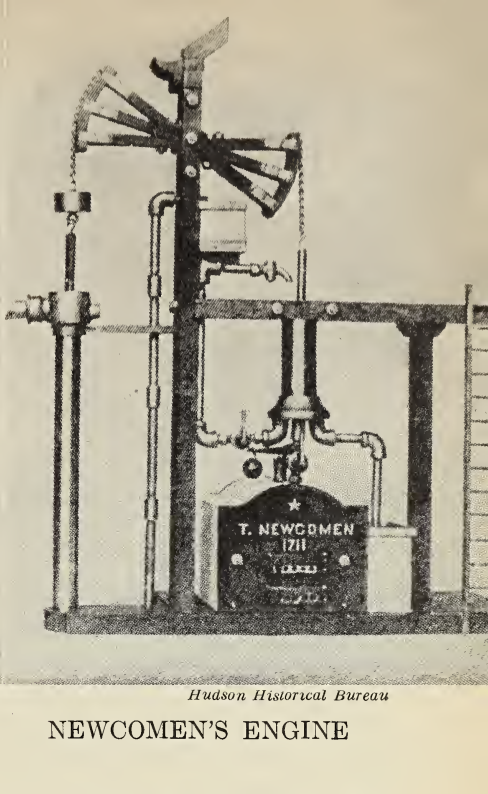
Finally Denis Papin, a Frenchman, made a crude steam engine. His engine was built to make steam push a rod back and forth within a cylinder. The rod was called a piston. When Papin saw the piston move as the steam pushed against it, he was delighted. His engine did not amount to much at the time. But his idea was important.

Two Englishmen, Thomas Savery and Thomas Newcomen, heard about Papin's engine. They became interested in finding out more about steam and how to make it work. Each of these men made a steam pump, using the idea of the piston and the cylinder that Papin had worked out. Savery's pump was not very practical, but we like to read about it because it was the first engine really to do work. Newcomen's pump was more practical than Savery's. It could lift about fifteen gallons of water at each stroke of the piston, and the piston could make twelve strokes a minute.

That was a pretty good pump — so the mine-owners thought. Some of them bought Newcomen pumps and put them to work in their mines. The

Culver Service

HERO'S ENGINE



Hudson Historical Bureau

NEWCOMEN'S ENGINE

first Newcomen pump was installed in 1711. By the use of these pumps, the miners were able to mine more coal for the iron smelters to use. The smelters were able to make more steel for the toolmakers. The toolmakers made new tools and better tools for the workers to use. And so, step by step, the story of progress went forward.

For a time the people seemed to be satisfied. They had found a fifth power to use in doing their work. No longer would they have to depend entirely upon human or animal muscles and upon the forces of nature — wind and water. They had developed *mechanical power*. They had learned to make power

from steam, and they had learned some of the things which steam power could do. But it took the people of England seventy years to find out that steam could be useful in many other ways.

Putting Steam to Work. I. What use did Hero of Alexandria make of steam? Why did people pay so little attention to Hero's invention?

II. Choose one of these men and see whether you can find his name in an encyclopedia or in other reference books. Report to the class the things that you learn about him.

Hero of Alexandria	Thomas Savery
James Watt	Oliver Evans
Denis Papin	Thomas Newcomen

Pumps in the Coal Mines. I. Explain how the problem of mining coal brought about the discovery of the use of steam.

II. Explain how a treadmill worked.

III. Explain how the Newcomen engine worked.

IV. What is the piston of a steam engine and how does it work? Perhaps somebody in the class can make a model of a piston moving in a cylinder.

A NEW HARNESS FOR STEAM

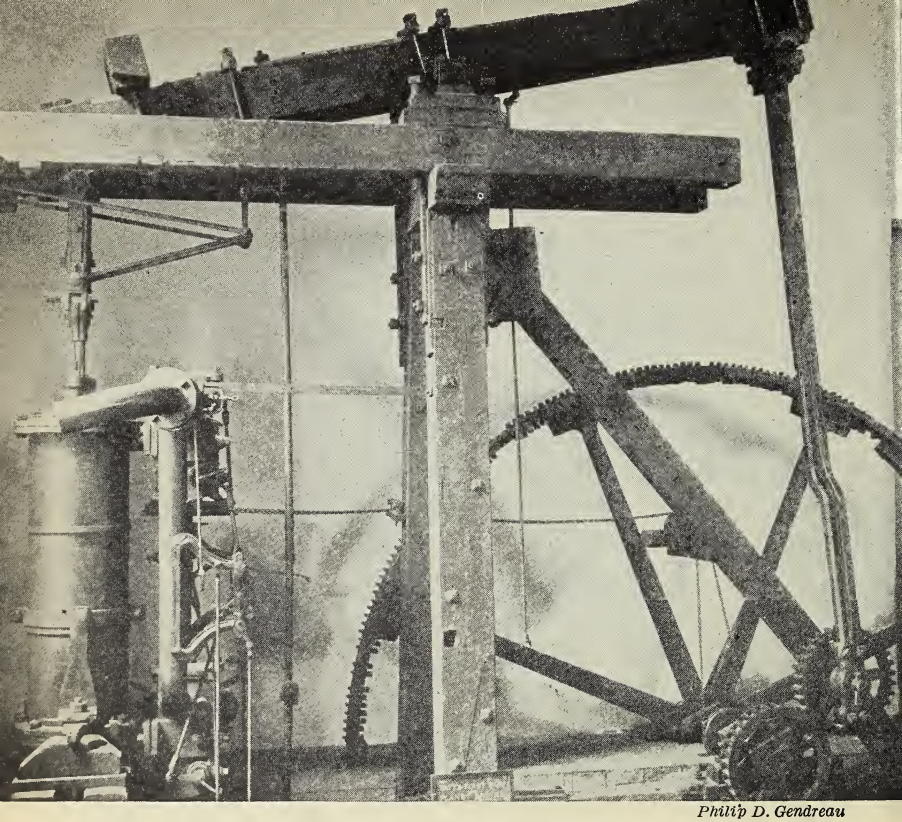
The people of England did not realize that steam could do many other kinds of work besides pumping water. They did not know that it could be made to supply power to run factories. They did not understand that it could be made to run machinery which

could lift heavy weights and drill holes and saw and cut and do all those heavy jobs which men had been doing for thousands of years. They did not understand their new worker. For seventy years this new power remained useless for other jobs than pumping because the people did not know how to harness it up so that it could do many kinds of jobs.

One day the people of Glasgow began talking excitedly about a new invention. They had reason to be excited, for an important event had taken place. Soon people in other parts of Scotland were talking about this wonderful invention. People in England were talking about it, too. People in other parts of Europe and in America were discussing it. What were they saying? Why were they so excited?

They were excited because James Watt had made a steam engine that was much, much better than the one made by Newcomen. Watt had placed water in a boiler. He had built a fire under the boiler. He had made steam. With the steam he had moved a piston. With the piston he had turned a crank. Newcomen had done most of these things, too. But by adding a crank to his engine, Watt could run a machine that would pump water or turn wheels or cut wood or turn spindles. Watt's engine could make steam do all kinds of work. Probably nothing had ever happened which so changed people's ways of living.

James Watt had worked on his engine for twenty years. He had experimented and changed parts



Philip D. Gendreau

JAMES WATT'S INVENTION

and made new parts and made over old parts until at last he was satisfied. Then Watt had turned his engine over to the people of England. Were they glad to get it? Indeed they were! Here at last was an engine that could do many kinds of work.

Watt sold his engine to coal miners at first, just as Newcomen had done, to pump water from the mines. Later the Watt engine came to be used in factories, in railroad locomotives, and in steamboats. In a few years it was doing much of the

work of the world. Steam, a mechanical slave, had really gone to work.

One of the first uses of the Watt engine was to run the new spinning and weaving machines which you have read about. It is important to remember that these machines were in the factories several years before the Watt engine was used to move them. How glad the factory owners were to get the steam engine. Factories could now be built wherever it was convenient for owners and workers. A steam engine could be put to work in any location.

Watt's Engine. I. Explain why Newcomen's invention of a steam pump made so little difference in the way of working in England.

II. Is it fair to say that James Watt invented the steam engine? Give reasons for your answer.

III. In what way was the Watt steam engine different from the Newcomen engine? Why did people become so excited over the Watt engine when they had cared so little about the Newcomen engine?

IV. Do you think the spinners and weavers of England objected to the Watt engine in the same way that they had objected to the improvement of their own machines? How can you find out?

Reading about the Steam Engine. Some of the books listed on page 16 will tell you more about the invention of the steam engine and about James Watt.

Look in the Index or in the Table of Contents of each of the books for such topics as: *Steam engine; Watt, James; Power loom; Factory system; Industrial Revolution.*

IV. THE INDUSTRIAL AGE

What had James Watt done when he gave his steam engine to the world? He had made possible a world of steam power and machines. He had changed craftsmen into machine operators. What was this changed world like? Were people more comfortable? Were they happier? Were they safer?

THE WORLD TURNS ABOUT

Sometimes there occurs upon the earth an event which changes the ways in which people work and live. Such an event changes civilization. Sometimes such an event may change civilization very rapidly. Sometimes the changes come more slowly.

When an event brings about great changes, we say it brings about a *revolution.* The word *revolution* means a turning-about or overthrowing. When an event in the world's history has caused great changes — a rather complete turning-about — we say it was a revolutionary event.

Such an event happened in 1781 when James Watt gave the world an improved steam engine. Watt's engine brought about great changes in the ways in which men did their work and in the ways in which people lived. The invention of the steam engine

started a revolution — a great change in the world. We call this great change the *Industrial Revolution.*

Up to the time of the Industrial Revolution the work of producing things had been done in homes. Workers were craftsmen; that is, they did their work with their own hands, using their own hand tools. They were paid for the products they made. But after Watt had made a steam engine which could be used to turn spinning and weaving machines, workers could no longer own the tools with which they worked. The new machines were too large to be used in the home. They were too expensive for workers to buy. And so the workers left their homes and went into factories to work. Instead of selling products that they had made, they sold their services to the factory owners. They put away their own hand tools and used the machines of the factory owners. They no longer planned their own work but followed the directions of men in charge of the factories. They worked regular hours — clock hours — beginning at a certain time and stopping at a certain time. They no longer planned their own days. The owners of the factories or the mines became the planners. The workers worked for wages. They did parts of jobs only, never finishing a piece of work. They were no longer craftsmen. They had become factory hands.

These changes in ways of working changed the ways in which people lived. Families no longer had time to raise their own food — they earned money and bought their food. They did not live on farms

or in farm villages — they lived in factory towns. They no longer had time to make their own cloth — they bought cloth from stores. Even the children had no time for play. Their work was needed in the mines and factories. Women left their homes in the morning and did not return until night. Their work was needed, too. Soon people forgot their folk songs and dances, for they had no time for pleasure. They lived by the clock — so many minutes for eating, so many hours for sleeping. They were no longer masters of their time.

These changes in ways of working and living changed people's ways of thinking, too. Men took less pride in their work, for they were no longer craftsmen. They began to think differently about tools and machines, for they no longer owned their tools. They felt differently about one another, for they no longer belonged to the guilds or craft clubs to which they had always belonged. They no longer spent hours and hours, as they had done in the past, learning a trade. There was no one to teach them. They learned in a few hours the one thing they were to do in the factories, and they did that one thing over and over.

People even changed their ideas about their houses and their home life. Many workers left the homes in which their fathers and grandfathers before them had lived, and went to live in houses near the mines and factories. That changed their feeling about their homes. Since they worked hard all day in

factories, they learned to go outside their homes for their pleasures. The simple pleasures of home life were no longer exciting enough after wearisome days in factories. Wives and mothers who worked all day in factories could not make the homes such happy and comfortable places to live in; so the families thought of their homes only as places in which to eat and sleep. When people change their ideas about their homes, their whole lives are changed.

During the Industrial Revolution even the appearance of the world changed. Peaceful villages changed to towns with smoking factory chimneys or to dirty mining towns. Rushing, smoking trains took the place of stagecoaches. Small towns changed to cities. Green forests changed to acres of blackened stumps and underbrush. Cottages gave way to tenement houses many stories high. Country roads changed either to steel tracks or to paved highways.

The Industrial Revolution began in England. It changed the appearance of England very rapidly, for the Revolution was a swift one there. Factories were built. Coal-mining and iron-mining towns sprang up. Many people left the farms and went to the towns and cities to work in the mines or in the factories.

In a few years the Industrial Revolution spread to France, then to Germany, and then to other parts of Europe. As fast as it spread to these countries,

the appearance of the countries changed. In some countries the Revolution moved very fast. In some countries it moved slowly.

The Industrial Revolution spread to America. It was slow to start in America; but after it started, it spread like a forest fire. How the countryside changed in appearance! Railroads were built. Trains went whizzing by. Steamboats took the place of sailboats. Bridges were built. Tunnels were bored through mountains. Highways were built. Cities sprang up, and in every city great, tall chimneys belched forth black smoke. Towns became grimy and ugly. Mining towns were scattered throughout the countryside. Forests were cut down. The whole country began to look different.

The Industrial Revolution brought the greatest change in living and working that had ever come to the people of the various countries of the world. Men harnessed steam in many ways, giving the people mechanical devices which worked for them in wonderfully quick time; mechanical devices which heated their houses and cooled them; mechanical devices which carried water into their houses and carried it out again; mechanical devices which carried people over smooth highways and steel tracks; mechanical devices which carried messages from one side of the earth to the other in lightning time; mechanical devices which picked up huge loads and moved them as though they weighed but an ounce;

mechanical devices which did the work of billions of horses. The changes which came with the Industrial Revolution remade the lives of men and women in most of the civilized countries of the earth. It gave them comforts and conveniences such as the world had never enjoyed before.

Everywhere that the Industrial Revolution has come, it has been the same. A new world! A world of noise — of whirring, clattering machines! A world of dirt — of smoke-stained air, lint-laden air, dusty air, air full of gas! A world of force — of wheels and levers and pulleys! A world of movement — of turning wheels, of speeding cars, of rushing trains, of revolving propellers! A world of physical comforts and conveniences — of mechanical devices that relieve people of many kinds of work and help them to enjoy better ways of living!

All of these great changes have come about within the last century and a half. Does it not seem surprising that so many changes could take place in such a short time? Does it not seem strange that changes of the same kind have been made in all these different countries? Does it not seem strange that the invention of the steam engine could start such a Revolution?

What Is a Revolution? I. Look up the word *revolution* in the dictionary to see what the word means. Why do we say that the world *turned about* at the time of the Industrial Revolution? *From* what things *to* what things did it turn?

II. Can you think of any other great world changes that you have ever studied which are called revolutions? What were these changes?

III. Do all revolutions come about by fighting? If not, in what other ways can revolutions be brought about?

IV. Sometimes we speak of the Industrial Revolution as though it were over. Is that true?

Reading about the Industrial Age. You may wish to read more about the Industrial Revolution in some of the books listed on page 16.

Great Changes in the World. I. Write a paragraph, explaining each of the following:

1. How the Industrial Revolution made changes in the way in which people worked.
2. How the Industrial Revolution made changes in the way in which people lived.
3. How the Industrial Revolution made changes in the appearance of the country.

II. There are several countries mentioned in this chapter which were changed by the Industrial Revolution. Choose one of these countries and find out some of the things which took place there during this period of change. See whether your geography or other reference books will give you the information.

III. Why did the cities in these various countries grow larger as a result of the Industrial Revolution?

Coal and Iron. Coal and iron became the most important minerals at the time of the Industrial Revolution. Are they still the most important minerals?

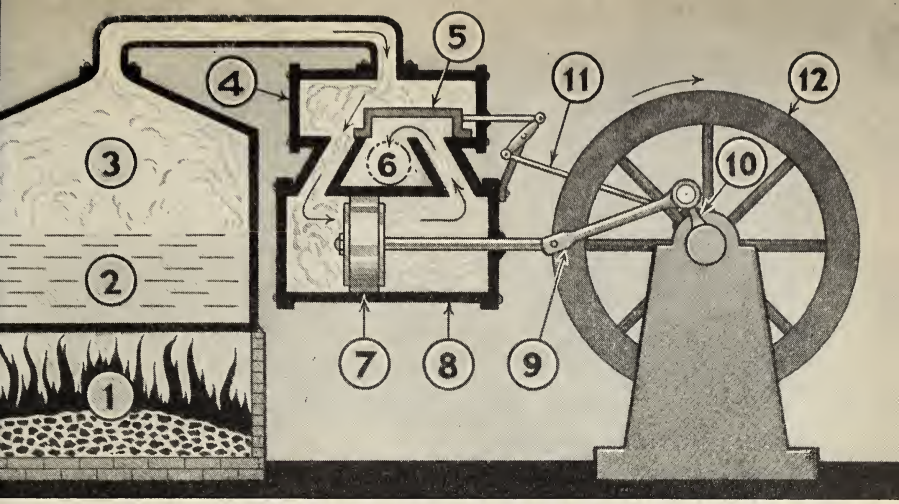


DIAGRAM OF A STEAM ENGINE

1. Burning fuel
2. Water
3. Steam
4. Steam chest
5. Sliding valve
6. Exhaust
7. Piston
8. Cylinder
9. Connecting rod
10. Crank
11. Eccentric rod
12. Fly wheel

ENGINES AND GENERATORS

The Watt engine started the Industrial Revolution. But other inventions had a large part in carrying on the Revolution and in bringing about the "Machine Age" in which we live today. For years the inventors have been busy people. They have never stopped making new machines for us to use.

You have read that the pressure or power in a steam engine, like the engine of James Watt, is supplied by steam. Steam is produced in a boiler, and from the boiler it is led by a pipe into a cylinder. The pressure of the steam in the cylinder forces a piston rod to move in regular motion, turning a crank, or in some other way operating a machine.

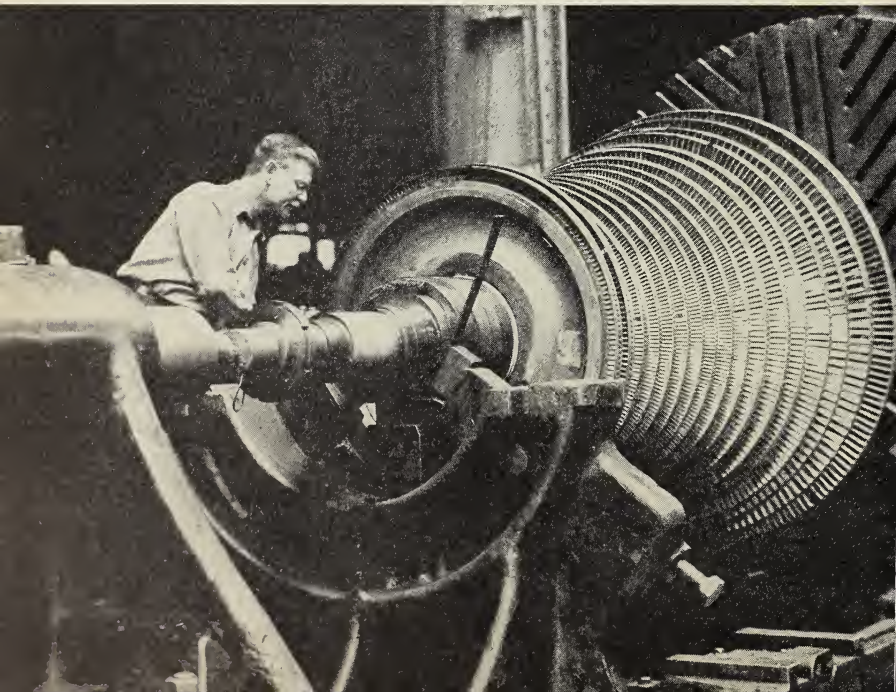
In the *steam turbine engine* the steam is forced against the blades of a wheel which are enclosed in a cylinder. The force of the steam revolves the wheel, and the revolving wheel puts a machine in motion.

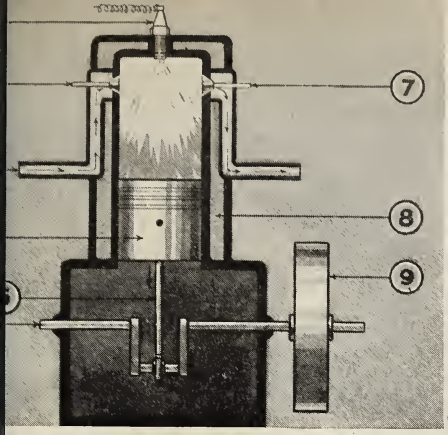
The steam turbine is often used to turn the propeller of a boat. The steam turbine is also used in city power stations.

The energy which operates both the steam engine and the steam turbine is the energy which is stored up in coal and released by burning.

The picture below shows a turbine wheel which has not as yet been enclosed in a cylinder.

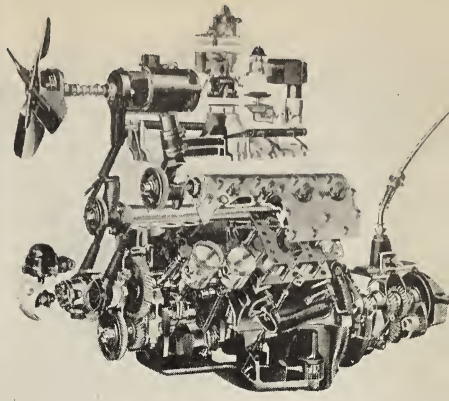
Courtesy General Electric Company, Schenectady, New York





GAS ENGINE

. Spark plug
. Intake valve
. Gas from carburetor
. Piston
5. Piston rod
6. Crank shaft
7. Exhaust valve
8. Water
9. Fly wheel



Courtesy Ford Motor Company

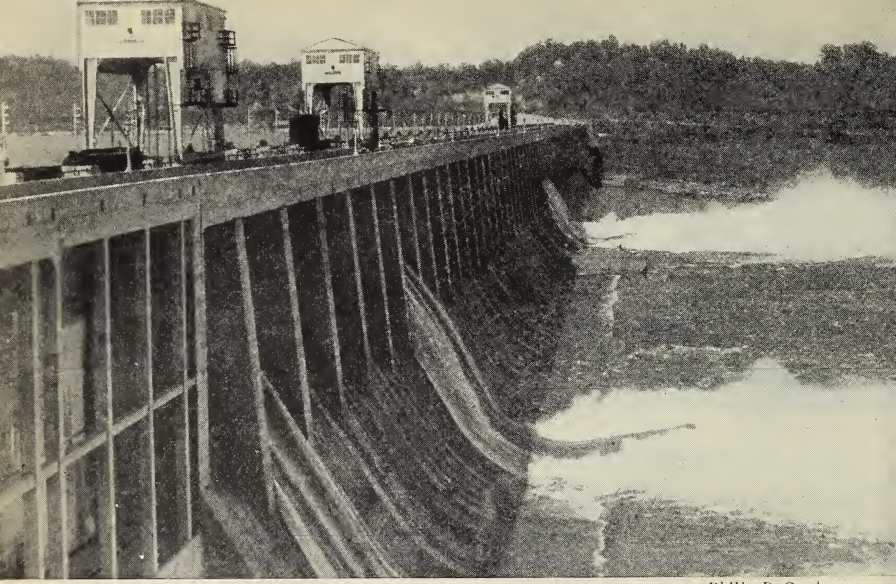
AUTOMOBILE ENGINE

The automobile engine is probably our most common use of the gasoline engine.

The *gas engine,* too, has a cylinder. But into the cylinder is sent gas which is made from gasoline. The gas within the cylinder is then made to explode by means of an electric spark. It is the explosion of the gas which pushes out the piston and supplies the force. The gas engine is used to run an automobile or an airplane. It is often used to operate machines in small shops and factories.

The steam engine, the gas engine, and the steam turbine are all harnesses for mechanical energy.

The *electric generator* or *dynamo* is a harness for electricity. A generator changes the energy of a steam engine, a gas engine, or a turbine turned by running water into electrical energy; that is, by the use of mechanical energy a generator makes an electric current. This current can be sent many



Philip D. Gendreau

CONOWINGO DAM IN MARYLAND

The water flowing from this dam turns great turbine wheels, and the turbine wheels operate electric generators.

miles to light our streets and houses, to heat the houses, to toast bread, to heat flatirons, to set off signals, and to turn the wheels of the machines in our factories.

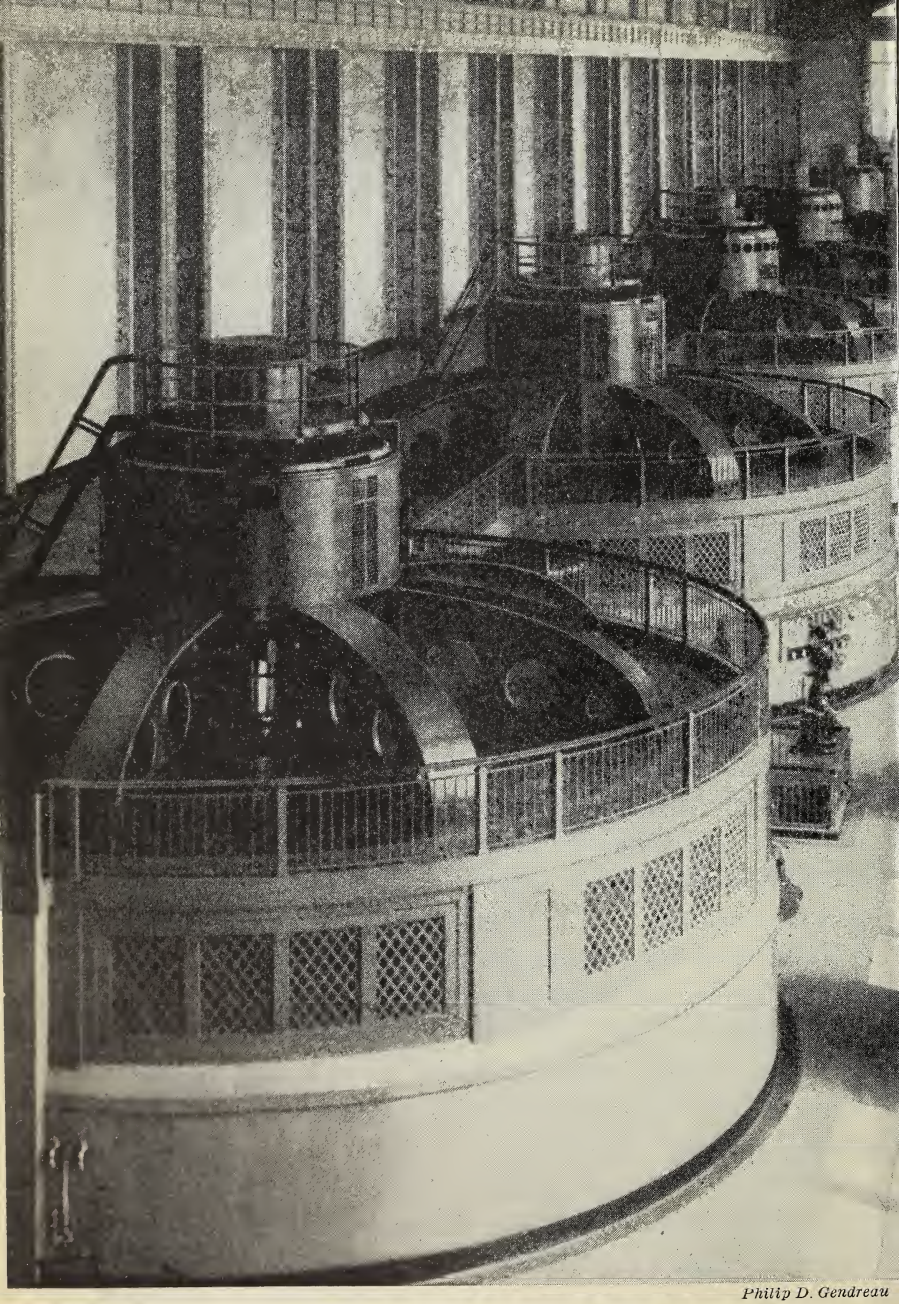
To supply water power for generating electricity, great dams like the one pictured above have been built in some of our rivers. Near the dams are the buildings which house the turbines and generators. Such a plant, which is used for generating and distributing electric power, is called a *hydroelectric* plant.

Engines and generators are used today to turn wheels and drive machines. They are called *prime movers*. Prime movers are working machines. They

are attached to other machines, and they furnish the power which turns the wheels and moves the cranks; which moves the belts and swings the cranes; which turns the saws and drives the knives; which raises the hammers and spins the propellers. Prime movers are the harnesses for mechanical power and electrical power. They make coal or water or electricity or gas do the pounding, the cutting, the holding, the moving, and the grinding which, before the Industrial Revolution, was done largely by the muscles of animals and men.

When James Watt first invented his steam engine, he wished to sell it to the mineowners. In order to do so, he found it necessary to explain to them how much work the engine could really do. The work of pumping water out of the mines at that time was sometimes done by horses. Watt had found out how much weight a horse could lift in one minute through one foot of space. He found this to be 33,000 pounds. For that reason, he said that the power required to lift 33,000 pounds one foot in one minute was one *horsepower*. He found that his engine could lift forty times that much weight the same height in the same amount of time; so he said that his engine was a forty horsepower engine. Since then, we have continued to measure the power of engines by horsepower.

Watt tried to improve his engine so that it could do more work than forty horses could do. Soon he had what he called a sixty horsepower engine.



Philip D. Gendreau

TURBINE HALL AT CONOWINGO DAM

Since then other men have worked on this problem. Now we have engines which have the power of hundreds of horses.

Prime movers furnish the force which makes the wheels revolve, the belts move, the cranks turn. But prime movers cannot weave, or sew, or drill, or pound, or cut. They can only run the other machines which can do these things. Without the wonderful machines which the minds of men have invented, the prime movers would be of little use. A prime mover is only attached to the machine which does the work. The power is turned on, and the work begins.

Prime Movers. I. What is meant by a prime mover?

II. Choose one of the prime movers. Read about it in the encyclopedia or in some book about machines. Make a report to the class, explaining how this prime mover works. Perhaps you can help the class most by finding or making pictures to show them.

III. Explain what is meant by horsepower. Why did Watt use this way of explaining the power of his steam engine?

IV. We have some huge power plants in America where electric power is generated through the use of water power. Below is a list of the places where some of these hydroelectric plants are located. Can you mention others of importance? Choose one of the following and report to the class the interesting things about it: *Niagara Falls; Conowingo Dam; Boulder Dam; Keokuk Dam; Roosevelt Dam; Muscle Shoals.*

MEN AND MACHINES

The invention of prime movers and of machines for carrying on the work of production has greatly changed man's ways of working. For thousands of years before the Industrial Revolution the smiths stood beside their handmade forges, working bellows with their feet. Each smith heated the metal and pounded it into shape with a handmade hammer upon a handmade anvil. If he were making a knife, he sharpened it upon a handmade grindstone. When the knife was finished, it was different from the knives made by other men. It was even different from the knife which this same smith made yesterday and which he might make the next day. Human hands cannot make two objects exactly alike.

It was much the same in the production of all kinds of goods. The weaver had his own loom. He had his own way of operating his loom. He might weave loosely, letting his threads lie far apart. Or he might weave so that his threads lay close together. The bolt of cloth which he made was different from the cloth made by other weavers. It bore his mark. People came to know a man's products, buying the goods because they knew the work of that man was excellent, or refusing to buy it because they knew his work to be poor.

In those days craftsmen took great pride in their work. They took great pride in their tools and machines. Good workmanship paid them well. A craftsman was known by the kind of work he did.

But since the Industrial Revolution ways of working have changed. Workers no longer own the tools they use. Tools and machines are the property of the factory owner, and all the workers go to the factory to use them. It takes large amounts of raw material to keep these huge machines running. A worker cannot furnish his own raw material. So the factory owner furnishes the raw materials, just as he furnishes the machines and the building in which the work is carried on. For these three reasons, workers today do not own the products of their work. The goods made in the factory belong to the factory owners.

Often hundreds of workers are employed in the same factory. Each one has his particular job. It may consist of doing one thing over and over, time after time, all day long, and day after day. But the one act has to be done at exactly the right time and in exactly the right way.

In the picture on page 100 is a moving belt. On the belt are automobile generators. All day long the belt passes before the rows of men. Each man does his special piece of work to each generator and puts it back into its place on the belt. The belt passes on, carrying away that generator and bringing another and another and another.

Such work is tiresome. A worker must not use an extra motion, for that wastes time. He must never let his attention wander, for he might make a mistake or let one generator go by him unnoticed.

Philip D. Gendreau

WORKERS AT A MOVING BELT

Automobile generators on a moving belt are passing before these lines of workers. Each man does his bit of work on each generator and puts it back into its place on the belt. The men must work as quickly and as automatically as machines.

He must not talk or move about. The work requires him to stand. Workers get very tired doing such monotonous work. They become bored and uninterested in their work. They take little pride in doing good work.

Workers today are paid for their time instead of for their product. They are usually paid to work so many hours each day and are paid by the week or month.

The Factory Worker. I. The craftsmen of earlier times did most of their work at home with their own tools. What has happened to change this custom?

II. In the modern factory system men begin work at the same time and close at the same time. Why is this custom followed? Who decides how long the hours of work shall be and what time work shall begin?

III. What are some of the things which factory owners should decide? What are some of the things which factory workers should help decide?

IV. Do you think it is true that work at a complicated machine is more tiring to the worker than work with a single tool? Can you explain why?

Taking a Trip. Plan a class visit to one or more of the manufacturing plants in your vicinity, if possible. What could you do in arranging for such a trip? What are some of the things you would like to know about a factory? Make a list of them. Some factories are not suitable places for children to visit because they are dangerous. What are some such dangers? In what kinds of factories would you find them?

V. MACHINES — MASTERS OR SERVANTS?

Machines are powerful and able workers. They have helped man solve one of his oldest and hardest problems. But they have also brought him a new problem, which he has not yet been able to solve. Will man solve this new problem?

AN AGE OF SCARCITY

For thousands and thousands of years, in nearly all parts of the earth, people were troubled over the problem of production. People had wanted food, but often there was not enough for everyone. They wanted clothing, but many had only very poor covering. They wanted houses to live in, but many were forced to live in hovels.

Why was this true?

Because their tools were crude, people could not produce all the things they needed. They became accustomed to the idea of scarcity. They expected to have a difficult time getting food and clothing and houses and fuel and all the other good things of life. Many people took it for granted that there would always be some people near starvation; that there would always be throngs of ragged people on the streets; that there would always be homeless people wandering about seeking shelter. They did

not dare to hope that conditions would ever be different.

During those thousands of years in which people were worried about their problems of production, they were trying hard to make better tools and machines. Tools and machines were most important to them — tools for cultivating the land; tools for getting minerals from the earth; tools for felling trees and cutting them into lumber; tools for getting fuel; tools for spinning thread and weaving it into cloth; tools for production!

And yet production never caught up with the needs of the people; for as time went on, the population grew larger and larger. Always there were more people to be fed and more people to be clothed and housed. Always there were some who could not have the things they needed. Always there were many who could not have the things they wanted.

We can speak of these thousands and thousands of years as an *age of scarcity* — an age in which production could not keep up with the needs of the people. It was a period of worry and fear. People worried if frost came early and ruined the wheat, for they thought they were going to starve. People worried if the lambs died, for they thought they surely must go cold for lack of wool for clothing. Men worried about many things; and well they might, for it was hard to produce goods with the tools and machines then in use, and the number of people upon the earth was increasing steadily.

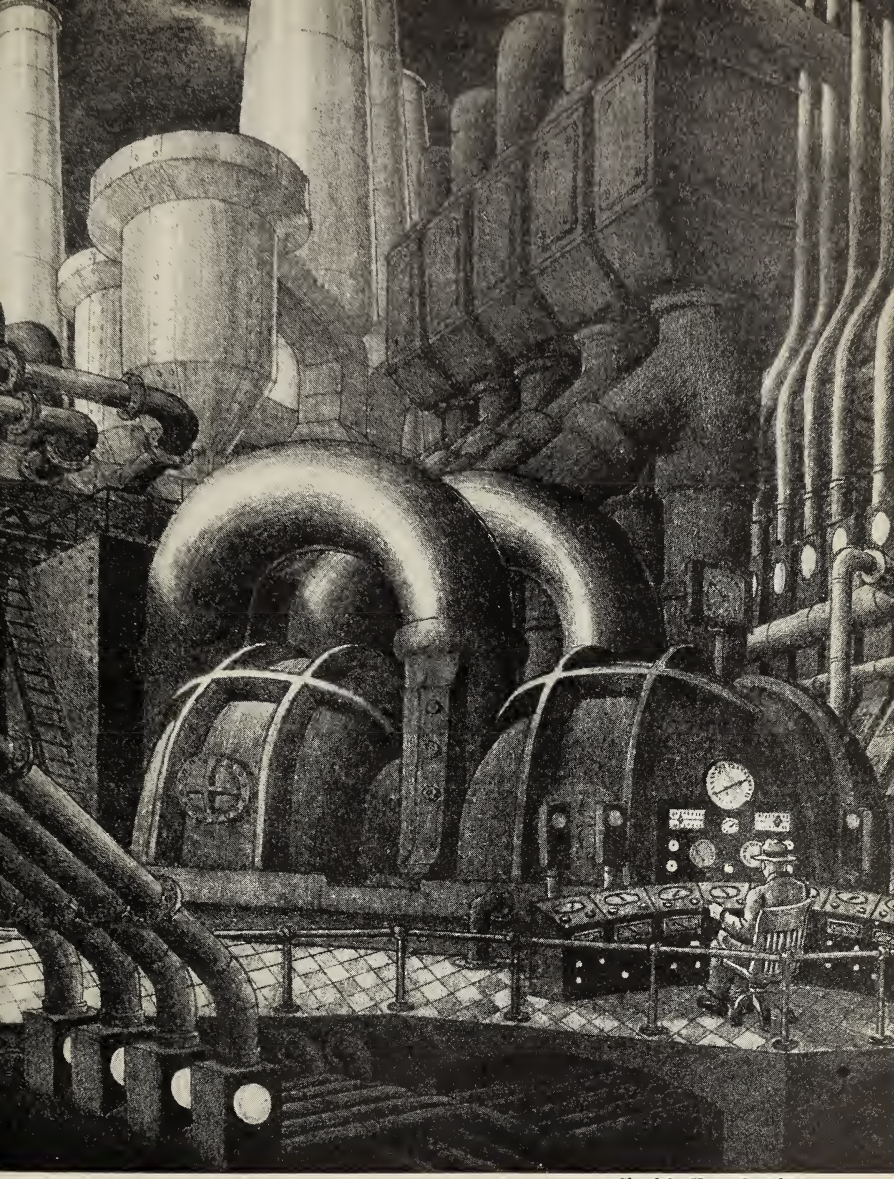
AN AGE OF ABUNDANCE

Finally, as you have read in these chapters, men learned to make wonderful tools and machines. They put their machines to work in huge factories. Great, powerful engines forced the wheels of these machines to turn. Day and night the wheels went whizzing round and round. Day and night the cranks darted back and forth and up and down. Great quantities of goods came pouring out of the factory doors. It seemed that the earth would be flooded with goods if the machines were not stopped.

Men had at last learned to produce goods enough to meet the needs of all the people of the world. They could do it with their wonderful tools and machines. The engines never grew tired. The machines never lagged. The problems of production seemed to be solved. It was an *age of abundance.*

But in this age of abundance there came a time when the wheels of the machines slowed down. Finally some of them stopped. The managers of some of the great factories closed their doors. Many men and many women no longer went about the work of production. What had happened? Were the machines not so good as they had been?

The machines were as good as they had always been. People wondered whether they were too good. At any rate, factories had closed down because too much was being produced. Goods piled up in the warehouses, in freight cars, in cold-storage plants.



Sketch by Harry Sternberg

ELECTRICAL POWER

By a movement of his hand one man can release electrical power that can turn the wheels of a thousand factories.

Goods stood on the shelves in wholesale houses and in stores. Goods were no longer selling.

Of course factory owners could not afford to go on making goods if people did not buy them. But neither could they afford to close their doors, for there stood those expensive machines and those expensive buildings which were making no money. What were the factory owners to do?

Really, it was an age of abundance for the producers but not for the people. Food and clothing packed away in boxes and cans and bottles and barrels! Lumber piled up in lumber yards! Tools and machines rusting for want of use! Merchants waiting for customers! And nobody to buy!

People continued to go about in poor clothing. Indeed, the patches became larger and the holes more noticeable. People walked the streets, pale with hunger and weak with lack of rest. They needed some of the food piled up in the warehouses and stores. They needed the clothing lying on the shelves in stores. They needed shelter and fuel and medicine and many other things. But they could not buy these things because they had no money. And they had no money because they had no jobs.

Men had learned to produce great quantities of goods by using machines. But the machines worked very fast. They made so many things, and they made them so fast, that people could not buy all that was made. People did not have money enough to do so, and they stopped buying.

Sketch by Harry Sternberg

POWER AND THE WORKER

Electric drills make it possible to drill into solid rock with little strain of human muscles.

When people stopped buying the things the machines made, factories stopped running. When the factories stopped running, men and women lost their jobs and had no ways of earning a living.

Machines, we see, have solved the problem of production. People need never again fear a lack of goods to meet their needs. Men have learned how to produce all they can ever sell. But people still fear hunger and cold and sickness. They still fear the loss of their homes; for unless people have money or a means of earning money, they cannot buy the abundance which the machines can produce. How can we solve this problem of the machine age — the age of abundance?

The Producer and the Consumer. Look up the word *producer* in the dictionary. Why do we call men who own factories, raw materials, and machines the producers? Look up the word *consumer* in the dictionary. Can a person be both a producer and a consumer at the same time?

Working Together. I. What do we call a period during which men cannot find work, factories close their doors, and money is scarce? Who do you think suffers most when this happens — the factory owner or the factory worker?

II. If both the factory owners and the factory workers suffer from overproduction, should they not work together to solve this problem? Do you think they should decide to stop producing so much goods? Can you think of a better way they might try to solve this problem?

WHAT WE OWE TO THE MACHINE

We are living in an industrial civilization, and our lives are closely bound up with machines. From the minerals of the earth we have fashioned creatures of iron and steel to do our work. Machines have changed an age of scarcity into one of abundance. Machines have brought great advantages to us. Let us see what some of these advantages are.

Machines have made it possible for man to bridge both distance and time. In the days before electrical communication it took days or weeks or even months to send messages to friends living in distant parts of the world. Today, messages can be delivered in a few moments' time. People separated by vast distances no longer feel alone or cut off from friends or home.

Today, people move swiftly over concrete highways in comfortable automobiles or busses or trains. They glide through the waves in steamships or fly above the clouds. The machines of transportation can bring together, in a few hours' time, people separated by thousands of miles of space. Such machines have made one's place of location upon the earth of far less importance than ever before.

Machines of transportation carry goods with such swiftness that those living in places of extreme cold may enjoy tropical foods. Those living on the edges of the deserts may feast upon foods which require much moisture for growing. Those living in lands

having neither coal nor oil can share the comforts of heated buildings with those living in the mining districts.

The machine has also made it possible for man to use new materials. It is hard to believe all the marvels of manufacture which the new machines can perform. Who would think, for example, that a beautiful fountain pen holder may have been made from fish scales and sour milk? Who would believe that the delicate dishes your mother prizes so highly may have been made from sand? Sand and fish scales and sour milk have been wasted for centuries. It was not until men were able to invent the necessary machines that many waste products could be made into things of use.

Machines have made it possible for men to use their engineering skill and knowledge in construction. Without machines, men could never have tunneled under rivers and mountains, or built marvels such as the skyscrapers that mark our large cities, or built dams that confine miles of flowing water in artificial lakes.

Engineers can perform these marvels of science because the machines they use can lift huge loads higher than men could ever lift them. They can move heavier loads than men could ever move. They can bore deeper holes than men could ever bore. Machines can cleave apart great boulders of granite. Could man have done these things without the aid of machines?

Machines can also do work which does not call for great strength. Machines can see beyond what the human eye can see. Microscopes are needed to find the invisible life that causes illness. Telescopes are needed to see the far-distant heavenly bodies. Machines can make finer adjustments than can be made with human fingers. Machines can detect sounds unheard by human ears.

Machines have provided men with undreamed-of luxuries and comforts at moderate prices. You have read of the treasures of gold and jewels hoarded by the kings of olden times. Yet those kings did not have bathtubs in their homes. They did not even have chimneys through which the smoke of their fires could escape. They did not have enough changes of clothing to keep them clean and comfortable. They did not have tropical fruits brought from a distance. Machines have made all these luxuries possible for men. Machines have made many necessities and even many luxuries both plentiful and cheap.

Machines have released the people of today from doing much of the drudgery that people did in past ages. And because we, in this age, do not have to do so much drudgery, we have more time for leisure. We have time to do some of the interesting things which we like to do. Our lives are richer than were the lives of many of our ancestors. All these things have come to us through the use of the machine.

Studying Modern Machines. Look in *Compton's Pictured Encyclopedia* or in other reference books for pictures of modern machines. Try to find some which you have not known about before. If you were going to design a new machine, what kind would you like to design? If you were going to run a machine, what kind would you like to run?

THE MACHINE AND THE JOB

Sometimes you may hear complaints that machines take work away from people — that machines are robbing men and women of ways of making a living. Is this true?

Perhaps there is some truth in this statement. It is true, for example, that in some cases men and women lose their jobs because the factory where they have worked has put in new machinery that does some of the jobs which before were done by human hands. But it is just as true to say that the machine makes new jobs for men and women. Think of the automobile. Before the automobile was invented, men worked in factories producing carriages and wagons and harnesses for horses. Then came the automobile, and it was not long before the carriage and wagon factories had to close their doors. The workers were without jobs. But new factories were opened up — factories which made automobiles. The automobile factories of today employ many more men than had been employed in the carriage factories of thirty years ago.

Think of the men and women employed today in making rayon, a textile which can be made only by machines with the help of human hands. Think of the men and women employed in tire factories — factories which have been opened up only because of the use of the automobile. Think of the men and women employed in paper mills and printing plants and newspaper offices. Thousands of new jobs have appeared to take the places of the jobs lost because of the introduction of machines. Every new invention or change in an old invention opens up new work to people. Every discovery of a new process opens up new work. People are constantly shifting from one kind of work to another.

We need to think, too, of new kinds of work which can be done in this world. Could we use more people in the work of beautifying our surroundings and in making our cities better places in which to live? Could we use more doctors and nurses? Do we need better roads and bridges, and therefore more engineers to plan them? Do we want more people to use some of their time in producing pictures and music? Do we want more people trained to help scientists in laboratories? These questions suggest some of the kinds of work that machines cannot do. Can you think of others?

One of our great problems is that we are not yet able to see all of the work that needs to be done. We still think the only important work of the world is producing food, clothing, shelter, the vehicles of

transportation, and the means of communication. Some of these things can and should be done almost entirely by machines. The kinds of work suggested in the paragraph before this one probably can never be done by machines. Perhaps some of it can be done by men and women who now tend machines.

Estimating the Worth of the Machine. I. Do machines have any part in furnishing your breakfast? Do you ride to school in a machine? Try to think of all the different ways in which you use a machine in one day.

II. Write a few paragraphs describing your imaginary experiences during a day spent in a land where there were no machines.

Mechanical Inventions. I. Do you think inventors should be encouraged? Which does the United States government do — encourage or discourage inventors?

II. Name some of the new jobs which have been created through the invention of machines. Be sure to include some that are not mentioned in this story.

Work for the Machines. I. Name ten kinds of work which you think machines can do better than people can.

II. Mention five kinds of work which you think machines can never learn to do.

III. Do you think all the important machines have been invented, or is it possible that some new kinds of machines may be invented?

IV. Do you like the idea that there may be new kinds of work for people to do? If that could be true, would you be willing for the machines to take the place of people as rapidly as they can?

New Kinds of Work. I. Make a list of things that you think it would be well to do (or to do better) which men now neglect because they have not time for them.

II. If you did not have to think of the money you earned, what kind of work would you like to do?

III. It has been said that the best pie has never been baked; the best tool has never been made; the best song has never been written; the best house has never been built. Do you believe this to be true? Perhaps you are the one who will do some of these things.

Leisure. I. If people were to work only a very few hours each day, what would be some good things for them to do in their spare time?

II. Do you think it important that people learn how to spend their leisure time well? If they do not do this, what may happen to them?

THE NEED FOR BETTER PLANNING

We have another problem of the industrial age which we have not yet learned to solve. It is the monotony of the job of just tending machines.

Can you imagine spending all the time of your working day fastening nuts on one bolt after another? Or placing bits of fat pork on top of cans of beans? Or tying broken threads all day long? Such jobs are tiresome. They make the worker feel dull. They cannot create in the worker a love for his work and an interest in it, such as was felt by the craftsman who made a whole article.

Can anything be done to relieve the monotony of such work?

Many people would not object to doing a few hours of this monotonous work daily. Perhaps in time the factory owners will see that workers who do it must have shorter hours. Perhaps the workers will spend only a few hours a day in such work, doing other kinds of work for the rest of the day. A girl in a textile factory might spend part of her time tying broken threads, stopping and starting her machine, and watching to see that all goes well. The rest of her day might be spent in doing such work as inspecting cloth for flaws. A change of work would rest her, give her interest, and keep her from disliking work.

Another problem of the worker is the use of leisure time. The machine has already given some people a great deal of leisure. If machines are made to do the heavy and monotonous work of the world with very little help from human hands, what will people do with their time? This is a serious question, for often idle people get into trouble.

It is to get ready for the time when we shall have more leisure that so much is being said about leisure-time activities. People who can see ahead tell us that the day is surely coming when none of us will have a long working day. If that time comes, everyone will want to know better ways of playing. Athletics of all kinds will be important. People will play games, take exercise, fish, camp, have hobbies.

Our national government is setting aside great areas of land for public parks. It is stocking some of our ponds and rivers with fish. It is trying to

preserve the wild animals and wild flowers that people may enjoy them. With good roads, better automobiles and airplanes, and more people owning them, people will be able in the future to take recreation in many ways.

Are we wise in objecting to machines? Instead of objecting to them, let us find out in what ways our machines are out of control. Then let us correct these faults. Let us make better use of our machines. Let us provide ourselves with a highly efficient means of production and so free the time of human beings for better living.

THINKING IT OVER

You have been reading in this story about the development of the simple tools of early man into the great machines of today. Is it not a marvelous story? Has it helped you understand the part the great machines have had in making us more comfortable today? Now that you have finished reading the story, talk it over to see what you have found out. Use the following questions as a guide in your discussion.

I. Why has it taken man so long to learn to use and to make the machines we have today?

II. Do you think modern inventors deserve as much credit as the earlier ones? Why is it easy to invent machines today? Why was it difficult to invent the first tools?

III. Each of the following inventions made great changes in the ways in which people lived. Explain why.

1. The first use of water power.
2. The invention of the steam engine.
3. The invention of the cotton gin.
4. The invention of the clock.
5. The invention of the printing press.
6. The invention of the automobile.

IV. Can you explain clearly why we say we are living in a machine age today? Of course you must find a better reason than the one so often given — that it is a machine age because there are so many kinds of machines today. How else can you explain it?

V. Mention some foods, some kinds of clothing, some vehicles, houses, and methods of communication which we have today that we could not have without the use of machinery.

VI. Do you think we could continue to have the things we have today if our supply of iron should give out? If our supply of coal should give out? Are these things being formed in the ground today? Give reasons for all of your answers.

VII. Why do you think inventors make new tools or machines?

VIII. What do you think we should do with our machines? What kinds of work would you plan for the workers if machines did much more of the work than they do at present?

UNIT II

TRANSPORTATION AND COMMUNICATION

Section I. Speed . . . . . page 121
Section II. Man Learns to Travel . page 135
Section III. Highways, Waterways, and Railways . . . . . page 161
Section IV. Community Travel . . . page 193
Section V. Transportation through the Air . . . . . page 207
Section VI. Instant Communication . page 234
Section VII. What about the Future? . page 251

I. SPEED

We are living in a world of speed. Faster and faster move wheels and propellers, carrying men over land, over water, through the air. Faster and faster speed messages over wires and on invisible air waves. What are our vehicles of speed? What are our magical instruments of communication?

A WORLD IN MOTION

The world of today is a world in motion. In the city, in the country, on the seas, in the air — everywhere people are traveling to and fro, goods are being carried back and forth, messages are speeding from place to place.

Look about you in the city. Streams of motorcars speed rapidly along. Trolley cars clang their way along the streets. Busses glide quietly up and down the streets, stopping at corners to load and unload passengers. Trucks trundle along, hiding other vehicles with their toppling loads of freight.

Beyond the busy center of the city lie the freight yards. There, switch engines move back and forth with clanging bells, sending black clouds of smoke into the city. Farther in the distance are tugboats chugging up and down their watery path in river or

harbor or lake, pulling or pushing loaded freighters or bulky steamers. And far above, a plane soars across the sky. Motion everywhere! A whole city in motion!

Out in the open country you may also see a world in motion. Motorcars speed over smooth highways, carrying people to work, to school, or to a pleasant day of recreation. Trucks lumber by, taking their heavy loads of freight to market. Busses filled with people glide from farm to town, from town to city, from state to state. Railway trains rush by, some with carloads of food, of machines, of animals, of all kinds of merchandise, and some with coaches crowded with people. Bicycles! Motorcycles! Airplanes! Boats! Pedestrians! Everywhere there are people and loads of goods traveling from one point to another.

But some of the activity of travel is hidden from the eyes of men. Great pipe lines buried deep beneath the surface of the earth carry their heavy loads of freight. Gas to be burned for fuel flows through some of those pipes. Through others, oil travels hundreds of miles without the help of wheels. Some pipes carry water into the cities, and through some the city sewage flows out. In great cities subway trains roar through underground tunnels, carrying thousands of passengers to and fro. And in other underground tunnels cables of telephone and telegraph wires carry messages throughout every minute of the day. A secret kind of transportation

and communication is that which takes place beneath our feet! Because we cannot see what is going on, we sometimes forget that it exists.

Everywhere in sight are other instruments of communication. Wires over which messages speed from one part of the earth to the other! Great radio towers sending and receiving messages which travel through the air! Motionless they stand, it is true! But words and signals, strains of music, and even pictures, both moving and motionless, travel with instant swiftness by their help. All of these, as well as automobiles and airplanes and trains and boats, belong in this picture of motion.

What is all this motion for? What does it all mean? It is man's effort to overcome distance and time. It is man's effort to bring together those who are far apart and to carry far away those who are close together.

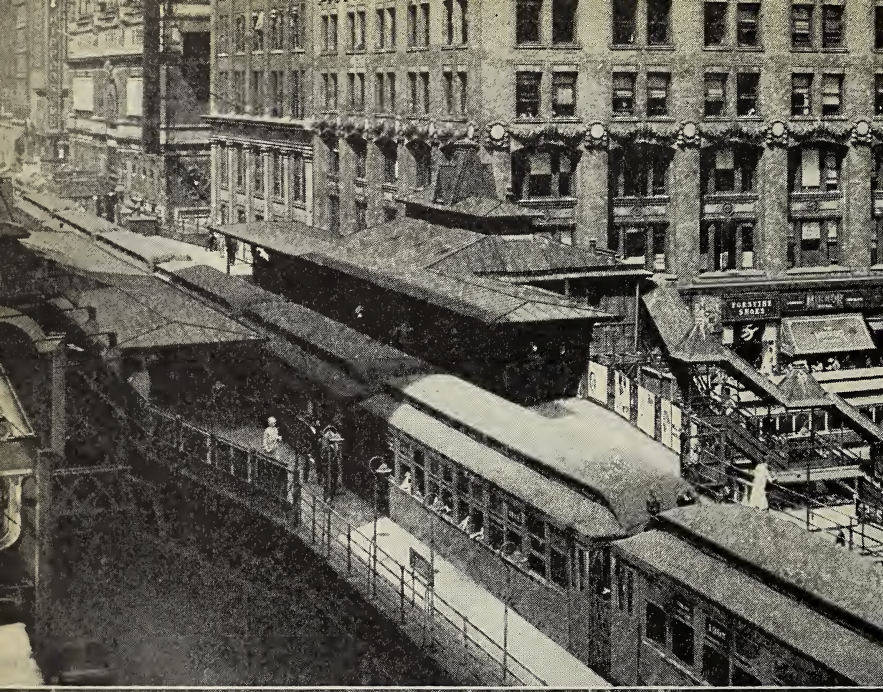
How man has been troubled with the problems of conquering distance! For thousands of years he has tried to solve these problems. The difficulty of getting places! The pain of travel! The tiresomeness of waiting! The inconvenience and delay in doing the things which men wish to do! The loss of time spent on the road! The heartaches from separation! As the years have gone by, man has asked again and again, "Are there not ways which will make it easier to see and talk to those who are far away? Are there not ways of making distances seem shorter?"

To shorten time and distance is the great problem of transportation and communication. Although wonderful things have been accomplished in the last one hundred years, man is still unsatisfied, for every step of progress opens up to the world new dreams and possibilities.

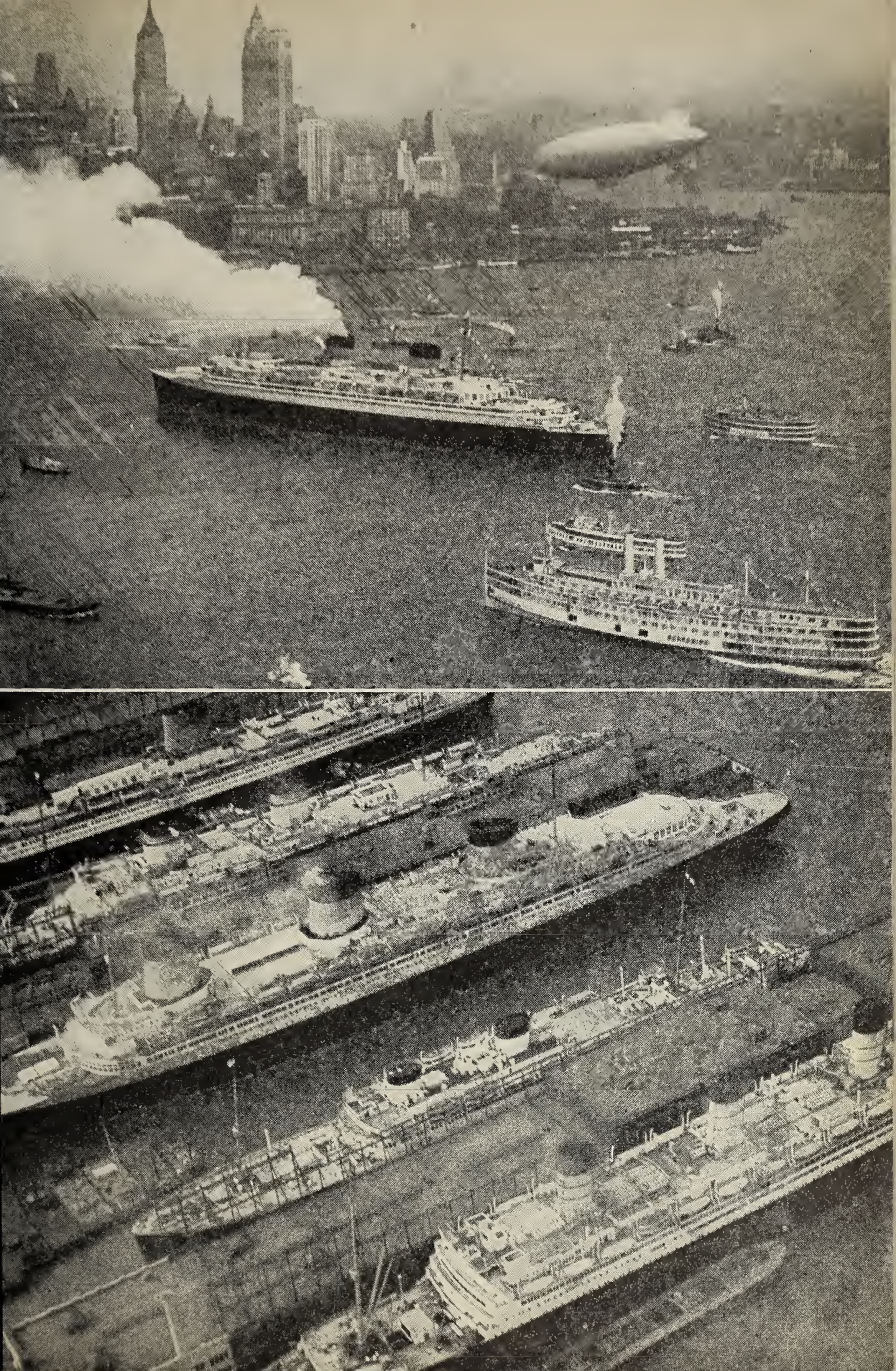
In our own time we are daily seeing the results of man's progress. In a day when most of our locomotives are of an earlier, slower type, a new streamlined train is an exciting piece of news. We frequently find the news of a new ocean monarch crossing the waters, and we watch its speed and time record in the daily papers with great interest. Even if we do not live in a locality where we may watch for the latest types of planes in the sky, we scan the aviation columns in newspapers and magazines for word of a new conqueror of the skyways. We live in an age of rapid progress, of record breakers. We are proud of man's latest achievements in speed. We are the inhabitants of a world of rapid travel and instant communication.

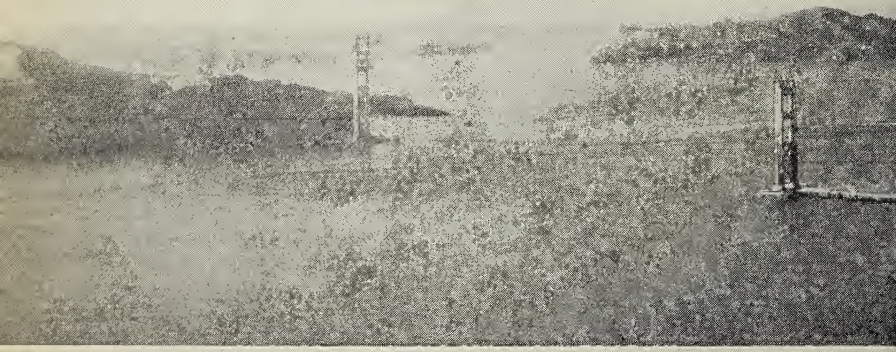
The pictures on the next few pages suggest some of the ways in which modern transportation and communication serve us and our needs. Study each picture and talk over the points of interest which you find in it.

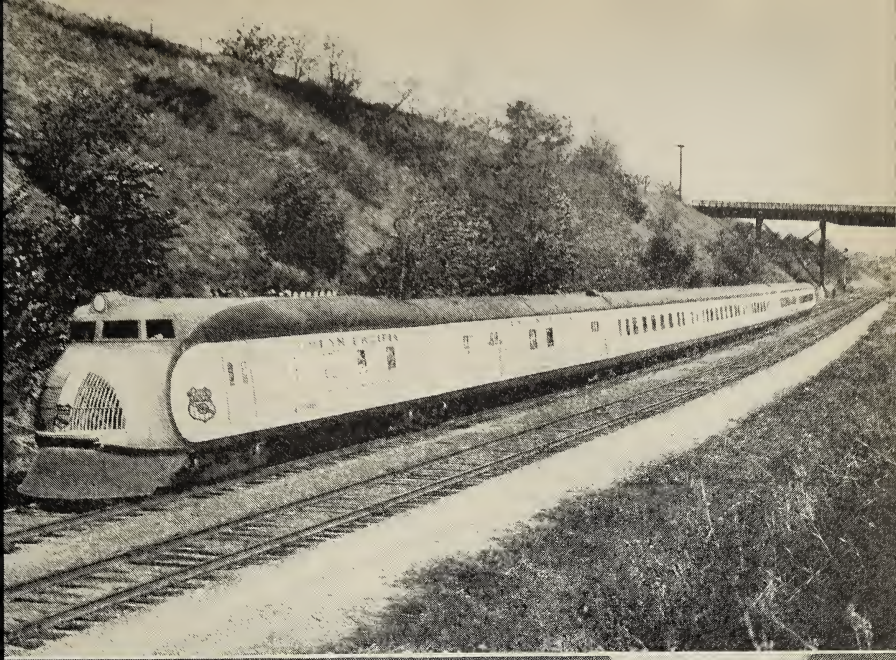
Credit note: Photographs are credited as follows: page 125, to G. A. Douglas from Gendreau; page 126, to Ewing Galloway; page 127, to Keystone View Company and Pictures, Inc.; page 128, to Lionel Green and Ewing Galloway; page 129, to Union Pacific Railroad and William M. Rittase; page 130, to Philip D. Gendreau; and page 131, to William M. Rittase.

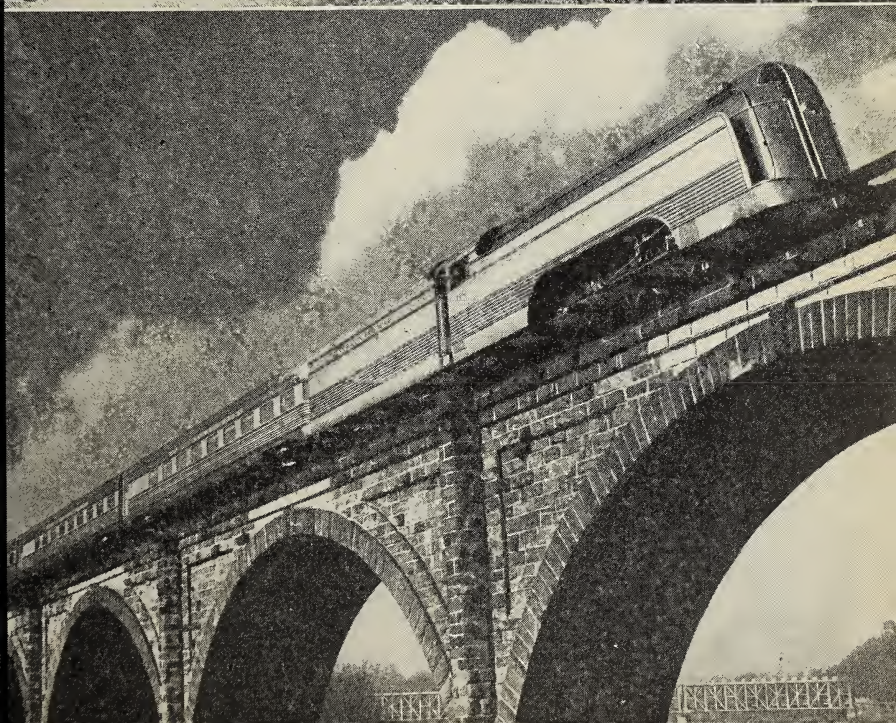

FORSTNER SHOES

17
6466









Record Breakers. I. What is the fastest railway speed record in our country? The fastest automobile record? Airplane record? Dirigible record?

II. Choose one of the record breakers in transportation. Find out all you can about it, and tell its story to your class.

A World in Motion. I. Stand at a busy street corner or traffic highway for a half-hour and count all the vehicles which pass — any kind of vehicle which transports people or goods. After you go home, make a list of the kinds of vehicles you have seen, placing them under such headings as: (1) Horse-drawn, (2) Motor, (3) Steam, (4) Propelled by Humans. You may make up the headings for your list.

II. For a week, list all the means by which you and your family send or receive messages other than through communication with people face to face.

III. Start a collection of pictures showing as many kinds of transportation as you can.

IV. Start a collection of pictures showing different means of communication.

V. Write a paragraph describing the most interesting kind of transportation that you know. Draw a picture showing the most interesting ride you have ever taken.

Planning to Study Transportation and Communication. I. Write out a definition of *transportation* as you understand it. When you have finished, find the word in the dictionary and see how correct you were. Do the same for *communication*.

II. Prepare a bibliography on transportation and one on communication. A bibliography, as you may know, is a list of books or readings.

Hunt through the books in your classroom and find all the stories which have anything to do with transportation. Arrange a list of these readings in groups as follows: (1) Water Transportation, (2) Air Transportation, (3) Land Transportation; or, (1) Transportation in Foreign Lands, (2) Transportation in America; or, (1) Transportation in Olden Times, (2) Transportation Today.

Arrange a similar list for communication.

In listing the titles of these stories, be sure to give the author's name, the correct title of the chapter or story, and the title of the book in which it is found, with the page or pages.

You will probably want to include in your bibliography some of the books in the following list:

How and Where We Live; An Open Door to Geography by Nellie B. Allen

How the World Grows Smaller by Daniel J. and Dorothea Beeby

The Young Folk's Book of Invention by T. C. Bridges

How We Have Conquered Distance by Maybell G. Bush and John F. Waddell

America Travels by Alice Dalgliesh

The Story of Transportation by Jeanette Eaton

The Picture Book of Travel — The Story of Transportation by Berta and Elmer Hader

Stories of American Pioneers by Sarah Dow Heard and M. W. King

The New Wonder Book of Knowledge by Henry Chase Hill and Will H. Johnston. See especially: The Story in a Newspaper; The Story of the Airplane and the Airship; The Story in the Telephone; The Story in Transportation; The Story in Television; The Story of the Talking Machine.

Paddles to Propellers (Our Changing World) by Helen Irwin

Great Moments in Science by Marion F. Lansing

Clear Track Ahead! and *Wide Road Ahead!* by Henry B. Lent

Explorers and Pioneers by William L. Nida

Makers of Progress (Science Readers for Silent Reading, Book V) by William L. and Stella H. Nida

Transportation (Great American Industries Series) by William F. Rocheleau

Travelers and Traveling (The Industrial Readers, Book IV) by Eva March Tappan

Travel by Air, Land, and Sea by Hanson Hart Webster

Compton's Pictured Encyclopedia. Find the topics *Transportation* and *Communication* in the Index. Note especially the set of pictures called "Scenes from the Pageant of Land Transportation."

III. Find poems about ways of travel or of sending messages that you think the class will enjoy reading.

IV. If you have copies of the *National Geographic Magazine* at home or in your class or school library, go through some of the copies and mark with pieces of paper those places in the magazines which give interesting pictures of foreign transportation.

II. MAN LEARNS TO TRAVEL

Man has struggled for thousands of years to learn better ways of transporting himself and his goods from one part of the earth to another. Why has he made this struggle? What kinds of vehicles has he invented for carrying himself and his belongings? What means has he found for moving these vehicles? How has he learned to make smooth roadways over which he may travel through forests, across plains, beneath mountains, over hills, and from bank to bank of the streams? In studying the history of transportation, you can see a pageant which tells the whole story of civilization.

MAN A SLOW CREATURE

Early man had no home, and he had no garden from which to get his food. He had to gather his food, picking it up wherever he could find it. That meant travel — hours of foot travel every day. It meant slow toiling through the brush and the trees of the forest. It meant trudging through swamps and climbing over hills. It meant wading through streams of water and plodding over deserts and plains. Man had to travel or starve.

In early days man did not travel long distances. He wandered over small areas — back and forth, up and down. Many times he visited the same places, hunting for his daily food.

Neither was early man a swift traveler. On and on he plodded, hour after hour of each day. He was seldom in a hurry. He did not think of getting things done in a period of time, as we do. All he knew of time was that a period of darkness followed a period of light, and that comfort and satisfaction followed a good meal. Getting his daily food was his only occupation. Man saw no need to travel fast for the sake of saving time. His only reason for increasing speed was for the sake of getting to a berry patch before he became too hungry, or of reaching a fishing place before the sun went down and it was too dark.

Although man was born a slow creature, he lived in a world of speed. Strong winds went whistling by him. Water whirled past. Lightning flashed through the sky. Birds soared over his head. Fish darted through the water. And almost every savage animal could outrun him.

Probably there were times when early man looked at the wild animals and envied them. The long, agile legs of the deer could run much faster than could his own short, clumsy ones. The muscles of the wildcat did not weary so quickly as his own muscles. The tough hoofs of the wild horses could travel longer than could his own tender feet. The wild creatures, he may have thought, had a much easier time searching for food than he had. They could travel faster and farther and could find their way in more difficult places.

For thousands of years man's feet were his only means of travel. At his best, man could run eight or ten miles in an hour. But at that pace he was soon out of breath, panting, sinking to the ground, too tired to go farther. His back was the first means of carrying loads too heavy for his hands to carry; and it was his only means of carrying loads for thousands of years. We do not know how long it was that man plodded on, using only his two feet for travel and his own back for carrying goods. No doubt it was a long, long time. Early man was slow in learning new and better ways of getting about, for he had no one to help him. He had to discover everything for himself.

Man a Slow Creature. I. Explain why we believe that the first need for traveling was food getting. Is food getting a need for transportation today? Make pictures contrasting the methods of travel for food at that time and today.

II. Explain what speed meant to early man. What does it mean to man today?

III. Pick out from pages 135–137 some good words or phrases to describe the difficulty of travel for early man. Do we suffer pain in travel today?

MAN A BURDEN CARRIER

As time went on, man began to collect belongings. He owned weapons and tools and tents, and bowls and baskets of food. Would he have to give up travel

now that he had belongings? Would he have to settle down and live in one place? Or could he find some means for moving his possessions from place to place?

Some groups of the early people settled down to live in one neighborhood, staying there an entire lifetime. They hunted and fished for a living or tamed animals or farmed. They solved their travel problem by not traveling. Other groups, however, would not do that. They were the nomads, or wanderers. They were happy only when they were traveling; so they had to think out ways of carrying their belongings.

Probably the *pack* was first used by these wandering tribes to carry their burdens. In some way they discovered that they could carry larger and heavier burdens by fastening them on their backs with strips of skin or with rough vines. What a discovery! Perhaps you think the pack a very simple thing to have discovered. Yet learning to use the pack was an important step in the development of transportation and a difficult one for early men to take.

Travel where you will today, you will see men transporting goods by means of the pack method. Men whose work is the carrying of loads are called *porters*. In Turkey it is not unusual to see a porter carrying six or eight chairs, tied securely to his back, one on top of another. The bent-over man at the bottom is nearly hidden by the bulky load, so that one might almost imagine that the load was walking

Ewing Galloway

PORTERS IN EAST AFRICA

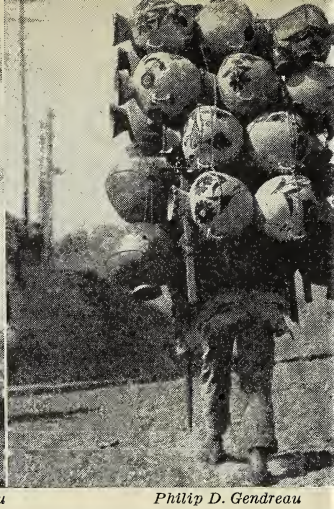
Primitive people today use the pack method largely, carrying loads either on their backs or on their heads. Notice the pad for the protection of the head.

around on a pair of legs. Sometimes one may even see a piano being carried through the streets of Constantinople on the backs of two porters. A porter must be very strong to carry such a load. He must know exactly how to hold and balance it.

Porters carry most of the freight which is transported in the African or South American jungles. Long lines of porters travel in single file, like a caravan, through the narrow paths of the dense forests, bearing on their backs or on their heads the loads of ivory or rubber or tea that are to be carried to the coast. In these regions an insect called the tsetse fly, which attacks only animals, makes it impossible to use animals as burden bearers; and roads for vehicles of transportation are very few in these unsettled regions. Men must carry the burdens.

Hudson Historical Bureau

IN CHINA



Philip D. Gendreau

IN GUATEMALA

The Chinese porter is using a carrying pole to help support his burden. Notice that in one of the baskets he is carrying his father. The Guatemalan porter is nearly hidden by his heavy load of jars.

In China, India, and Japan, coolies act as porters, carrying heavy loads strapped to their backs. In Siam, Ceylon, and Mexico, too, laborers think nothing of starting on long journeys carrying huge packs.

Even in our own country and in most of the more advanced countries of the world, the pack method of transportation is still used for some purposes. Men called *stevedores* often load and unload ships by that method, especially at smaller docks where more modern equipment for loading and unloading vessels is not provided. Peddlers carry packs as they tramp over dusty roads. Deliverymen with loads of merchandise on their backs tramp through the streets.

Porters have learned various ways of making burden bearing as easy as possible for themselves.

Sometimes they make pads of soft bark or cloth to fit over their backs or shoulders where the packs rest. Sometimes they use huge, light baskets, slung over their backs, to carry the goods. When they carry packs or baskets on their heads, they protect the heads with soft pads. Often they use straps with which to fasten the loads securely to their bodies so that they will not fall. In some countries men have learned to wear yokes across their shoulders and to hang a load at each end of their yokes to distribute the weight and thus make it easier to bear. The pack method is thought to be the oldest form of burden carrying, and it will probably be always in use.

A second step in burden carrying was taken when men invented the *litter* as a method of transportation. The earliest litter consisted of two poles placed upon the shoulders of two men, with a burden of some kind resting on the poles. The two poles may have been lashed together with leather thongs. Perhaps this first litter was used for carrying some chieftain or proud member of the tribe. Probably the litter was the first passenger vehicle ever invented.

Today the litter type of transportation is used in many countries. In India there is a vehicle of the litter type called a *dooli*. Many countries use the *sedan chair*, which is an improved form of the litter. The *palanquin*, which is used in various countries where human muscles are still the means of carrying travelers, is also a litter. The ambulance cot used in our own country is a kind of litter.

Perhaps the use of the *sledge*, or sled, was the third step in improving transportation. It probably first appeared as a *drag*, which in the beginning was the forked limb of a tree, stripped of some of its branches, and used as a means of carrying home a slain animal that was too heavy to carry by the pack method. The sledge was made of two poles or two logs fastened together and dragged over the ground. In time, men learned to fasten a platform upon these runners to hold the load. They learned to turn the runners up at the end, so as to make them glide more easily over rough places.

For thousands of years, even after civilization had begun in different parts of the world, the sledge was used as the chief means of transporting goods. It is still used in countries where there is much snow and ice, such as Alaska, parts of Canada, and Siberia. The sleds which you use today for winter sports are patterned after the early sledge.

During the same period of time in which the pack, the litter, and the sledge were invented, man discovered the use of waterways for transportation. It is thought that the first watercraft was a floating log, and that its first use was accidental. But, in time, man learned to use a log to float himself downstream and even to use a pole to steady and steer the log. Later, man learned to point the log at one end, so that it would cut through the water with greater ease, and to hollow out the log. A hollowed-out log was the first boat.

The Bettmann Archive

VEHICLES OF THE LITTER TYPE

Above, you see a litter borne by horses, used in Europe in the fourteenth century. The horse litter probably originated in China. Below is an early Italian sedan chair, used for transporting people of wealth.

The Bettmann Archive

From a diorama in the Science Museum, South Kensington

FIVE THOUSAND YEARS AGO

Men of the New Stone Age used the sledge. Notice the dugout canoes for water travel.

Man the Burden Bearer. I. Tell the reasons why man had to find ways of carrying burdens.

II. Find pictures that show the use of the pack method of carrying goods in various countries and for various purposes. Be prepared to tell a story of each picture and to locate the country in which each type of pack is used.

III. Find pictures of different kinds of litters used in various parts of the world.

IV. In this book, in your geography, and in books of travel, find pictures of the use of the sledge by people today.

ANIMAL POWER

We do not know how many thousands of years man had to depend upon his own muscles for transportation. It was a long time. Then he made a wonderful discovery. He found that he could tame wild animals and teach them to carry loads.

How he made this discovery nobody really knows. It is thought that wild animals were first tamed for pets. Perhaps some boy, playing with his pets as you play with yours, discovered that he could mount his camel or horse or water buffalo and ride him. Perhaps some hunter discovered that his dog could help him drag home the deer he had killed. Gradually men learned to make use of these discoveries and put their pets to work. In time, they had herds of tamed animals to carry their burdens for them.

Hudson Historical Bureau

TRANSPORTATION ANIMALS IN COLD LANDS

The dog and the reindeer are well equipped to endure the cold of arctic lands. The reindeer is one of the swiftest of the animals used for transportation.

Hudson Historical Bureau

At first, no doubt, men chose their animal helpers largely by chance. They did not ask which kind of animal was most suitable for the work of transportation. They just tried out various kinds of animals and found some suited them more than others because they were better travelers. In this way they learned what makes some animals better than others for transportation purposes.

Perhaps *endurance* is one of the qualities which men first learned to prize in their transportation animals. Animals must be able to withstand thirst and hunger. They must be able to endure the extremes of heat and cold. They must be able to withstand fatigue. Animals must be able to walk for hours and hours up the sides of mountains, through muddy swamps, or over deserts. They must be able to walk slowly or move rapidly without giving out. If animals are to be of help to man in his travels through the dangers of the forests, the mountains, the swamps, and the deserts, they must be able to endure more than man can endure.

It is no different today. People in cold climates select for travel those animals which are well protected by thick coats of fur or hair. In Greenland or Lapland the people choose the reindeer or certain breeds of dogs for their means of transportation. People in Tibet use the yak to carry burdens. The beasts used in cold lands must also be those that need little food and can travel for hours without rest. In the same way, beasts used in hot lands are

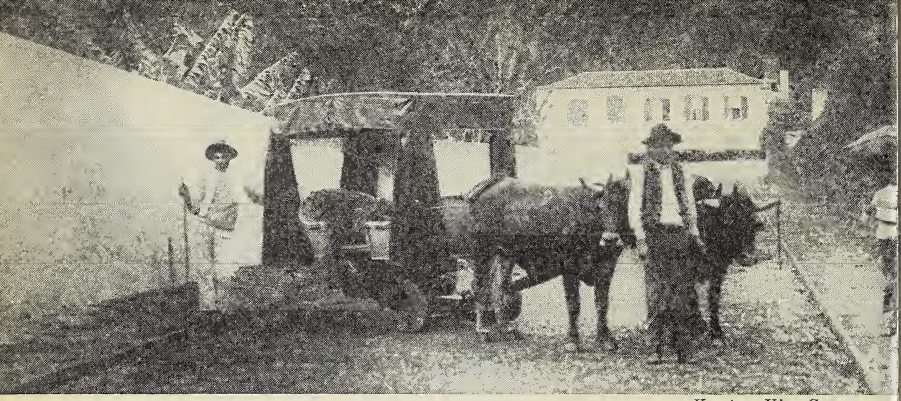
those adapted to a hot climate. For desert travel, people choose the camel.

Men learned to prize their transportation animals for *strength* as well as for endurance. The animals must be able to draw heavy loads. They must be able to bear up under heavy packs. They must be capable of working in teams, too, so that when a load is too heavy for one animal, others can be hitched to the same load. Horses, mules, camels, elephants, oxen, and yaks are all strong animals. They are used wherever strength is more important than other qualities.

People have learned to prize *sure-footedness* in their transportation animals. Such animals must be able to keep their footing no matter what the condition of the ground is. In many places the horse, the camel, the elephant, the mule, and the yak are sure-footed enough for most of the work of transportation. But in those parts of the earth where the mountains are steep and the paths narrow and rough, the burro and the donkey are highly prized. Many of the villages of Mexico can be reached only with the help of these little beasts. Up, up the mountain sides climb the burros. Sometimes the path is so steep that a rider can hardly keep from slipping over the burro's tail. In parts of South America, in the West Indies, in Sicily, Italy, Portugal, and Spain the donkey and the burro are favored beyond all other beasts. Their sharp little hoofs can dig into the crevices between the rocks to gain a sure foothold.

Keystone View Company

A DEPENDABLE CARRIER IN INDIA



Keystone View Company

A BULLOCK-DRAWN SLEIGH IN MADEIRA

Ewing Galloway

THE BURRO AS A MILK CARRIER IN SALAMANCA

Intelligence has been highly prized in transportation animals. It is said that the elephant is the most intelligent of all the beasts in captivity. In India the elephant is used in getting timber from the dense forests. He works almost like a man in finding ways of disentangling logs and floating them out into the open currents of the rivers. Dogs and horses rank next to the elephant in intelligence.

Another prized quality in transportation animals is *gentleness*. Animals kept in captivity have to be cared for. It is difficult to care for fierce beasts, as any keeper of a zoo knows. Untamed beasts would be dangerous for people on the highways. Most of the animals used for transportation are gentle and affectionate.

For thousands of years men used animals for transportation without giving much thought to the matter of *speed*. Speed was not important in those years because time was not important. Then, too, men did not attempt to travel over long distances. But, in time, men became roamers and learned to build roads and invent vehicles. They learned to enjoy traveling over longer distances. Then speed became an important quality in the animals which they used. It was then that the horse really became important to men.

The horse had all those qualities which men desired in their animals, although he did not always rank highest in these traits. He had endurance, though not so much as the camel and the yak. He had

strength, though not so much as the elephant or the ox. He had sure-footedness, though not so much as the donkey or the burro. He had intelligence, though not so much as the elephant. But the horse had gentleness, he had beauty, and, best of all, he had speed. The horse became the most important transportation animal known to man, and he has held that place for hundreds and hundreds of years.

Today the speed of the horse is not important to many people of America and Europe. Automobiles, trains, and airplanes have taken the place of the horse. But the speed of the horse is still important to millions of people living in backward countries. Along the edges of the deserts, among the hills, over the plains, where people have not yet gathered in large numbers, the horse is still man's fastest means of transportation.

Training the Animals for Travel. I. Many kinds of animals are used for transportation today. Make a list of them — as complete a list as you can make. Opposite the name of each animal tell in what country or countries he is used, for what purposes, and why he is used for those purposes.

II. Write a paragraph describing a camel caravan. There are many descriptions of camel caravans. Probably you can find some in your geography or in an encyclopedia. Illustrate your paragraph with a picture that you make.

THE WHEEL

So necessary is the wheel in our everyday life that it may seem to you that man must always have known and used it. But that is not true. Indeed, thousands of years went by before man invented the wheel as an aid to travel. Still other years went by before the wheel became a part of a machine.

It is thought that the Egyptians, the Babylonians, and the Chinese — those peoples who were the first to reach a high degree of civilization — lived and worked for thousands of years before they discovered how to make and use the wheel.

Some groups of primitive people, like the American Indians, never used the wheel. Probably the wheel was as surprising to the Indians as were the firearms and the ships which the early settlers brought to this country.

The exact group who invented the wheel and the time or place of its invention are not known. Some say it was the Babylonians who invented the wheel. Some say it was the Egyptians. Some say it was the Chinese. Most people agree that it was invented at some time before 3000 B.C. The oldest pictures of the wheel are those found among the records of the Babylonians and the Egyptians.

The first wheels were quite unlike those we use today, for the wheel developed slowly into its present form. Let us try to imagine how men may have discovered its use as an aid to work.

Perhaps a heavily loaded sledge, to which human slaves were hitched, was being moved forward inch by inch. Under the eyes of an overseer, the poor men pulled and strained at the ropes. In their path was a log. Because they were tired, or perhaps because no one thought of a better thing to do, they started to pull the sledge up over the edge of the log instead of taking the log out of the path of the sledge. But look! The log caused no difficulty! Instead, the sledge began to move forward quickly and easily as the log beneath it rolled! The watching overseer saw the ease of the motion. When the log slid out behind, he motioned to two of the men to place the log in front of the sledge again. Once more the straining slaves lifted the runners over the edge of the log. Once more the sledge moved forward easily, and the log rolled out behind. With little effort the slaves had moved the heavy sledge quite a few feet. The overseer was delighted with his discovery. He divided his workers into two teams — one team to pull the load and the other to place logs in front of the sledge. Other workers soon found out about this new way of moving heavy loads by means of rollers. It was much easier to use rollers than it was to pull the sledge over ruts and through mud.

For a long time the roller was the chief means for moving heavy loads. But men continued to look for ways of improving their work and of lightening labor. After all, replacing the rollers under the load was a laborious task. How could it be avoided?

Keystone View Company

AN OXCART IN SALVADOR

This crude cart is used to transport crops to market. The wheels on the cart represent a primitive stage in the development of the wheel. Notice the solid wheels and the wooden tires and hub.

Finally someone thought of sawing disks from logs, and of fastening two disks to the ends of a pole so that they revolved easily around the pole. By placing a load upon two poles, each connecting two revolving disks, they could push or pull the load forward easily and without the trouble it took to change rollers. What a remarkable discovery! The wheel and the axle had been invented.

In time, men learned to place a fixed platform across one or two poles, thus making the first two-wheeled and four-wheeled carts. This clumsy cart was much better than anything men had had before. They were so well satisfied with it that it probably was a long time before some clever person made an improvement on the wheel. It was found that if portions of the disk wheel were cut away, the wheel became

much lighter. This improved wheel was the forerunner of the wheel with spokes. Later, men made the wheel stronger, first, by binding the rim of the disk with strips of tough wood, and still later, by binding the wheel with metal rims, or tires. Finally, within recent years, men learned to cover the rims with solid rubber tires and then with rubber cushions of air. Rubber tires have added much to the comfort of travel.

The invention of the wheel was of great importance to the human race. As we know it today, the wheel represents the work of thousands of people and thousands of years. But the work of all those people has not been lost, for today the wheel is one of the most important factors in industrial civilization.

The Wheel. I. Make a collection of pictures of wheels of various kinds. Study the wheels in your collection. How do they differ in size? How do they differ in the kinds of materials from which they are made? How do they differ in the way the spokes are fastened to the hub and rim? How do they differ in their use?

II. Explain why the invention of the wheel has been important in the advancement of civilization.

III. Write a paragraph describing some other way in which the wheel may have been invented. Illustrate your story.

IV. Make pictures showing important differences between the first wheels and the wheels of today.

V. Draw a wheel and label each of its parts.

ROADS

For thousands of years after its invention the wheel was used mainly for war chariots or for the transportation of very heavy loads in carts. One would think that improvement in land transportation would have gone forward by leaps and bounds after the invention of the wheel; but it did nothing of the sort. Most people continued to walk wherever they wished to go, just as they had always done. The few people who took long journeys traveled on horseback. People of wealth or of high rank had litters of one kind or another. The ancient people had human slaves to carry them and their goods. The litter was still the most comfortable way of traveling, and the pack method was one of the best methods of carrying small loads.

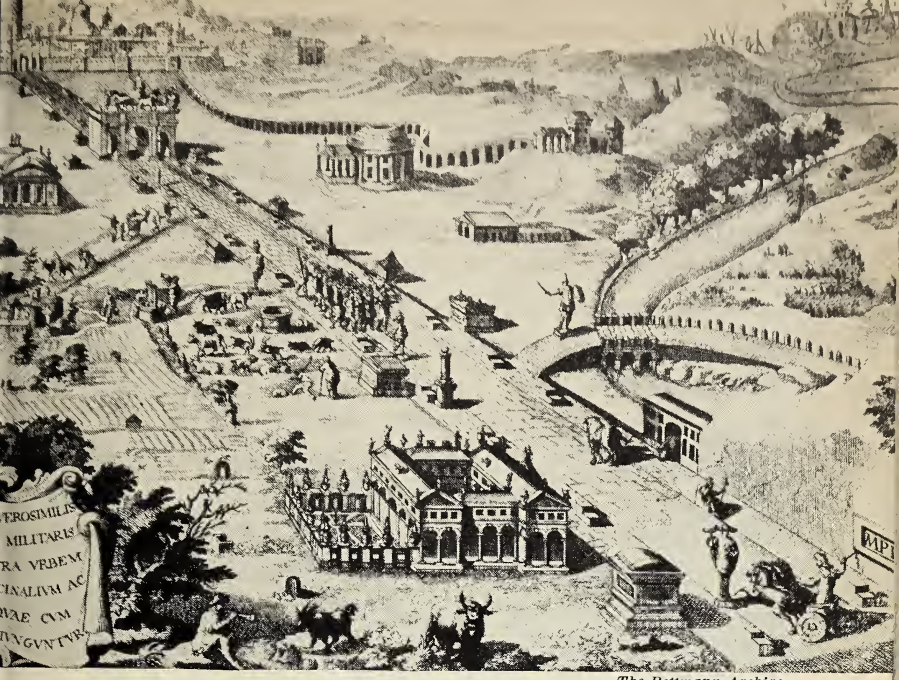
Then, too, you know, there were few good roads in ancient times. Narrow, crooked paths, worn by human feet, led through forests and farmlands and connected villages and towns. Men could run swiftly along these paths, carrying messages or transporting packs. Harder and harder grew the paths, beaten by the travel of thousands of feet over thousands of years. They were the only roads men had — the footpaths of messengers and traders.

A great change came, though, about two thousand years ago. At that time Rome became a mighty power in the world. The armies of Rome traveled north, south, east, and west. They went farther and farther away from the Italian peninsula into new

lands, strange lands — lands of which the Roman citizens had never before heard. And wherever they went, the armies conquered the people, took the land for their own, and made these new lands and new peoples part of the Roman Empire.

How could the Romans rule these distant lands? It took months to travel from Rome to the distant parts of her great Empire! But the Romans usually found ways of doing things they wished to do. They were skillful engineers. So they built roads — great, smooth highways — thousands of miles in length. Twenty of these highways led out from the city of Rome, pointing in every direction, like the spokes of a wheel. These twenty roads carried the Roman armies into Spain, into northern Europe, into northern Africa, and into western Asia. Before they had finished, the Romans had built 48,000 miles of roads. The world had never before seen such an outburst of road building. Never had the world seen such roads, either. They were straight and smooth and wide. They were built so well that some of them have lasted to this day.

Roman roads brought about great changes in the wheel. It became lighter and less clumsy. It was made stronger and smoother. Improvements were made in the use of the axle. Improvements in roads have always brought improvements in vehicles of transportation. And improvements in vehicles have always demanded better roads. That is the way progress is made.



The Bettmann Archive

A ROMAN ROAD OR MILITARY STREET

These Roman roads bound together the whole civilized world except the Far East. They made possible transportation and communication between Rome and the Roman army which defended the provinces; between Rome and the Roman people who lived in the provinces. After the roads were built, messages could be sent by swift horsemen faster than ever before in the history of the world. Goods could be sent back and forth — things which the provinces needed that were made in Rome; things which Rome needed that were produced in the provinces. Quick communication between Rome and her provinces connected widely separated parts of

the world in a way never before known. For eight hundred years Roman roads furnished to the world a means of quick transportation and communication.

When Rome lost her power, progress in transportation stopped for a thousand years. Then, about the time that Columbus discovered America, people again became interested in good roads and travel. A Hungarian wagon builder made a coach, the first horse-drawn vehicle planned for carrying passengers comfortably. By 1550 the new vehicle had become very popular with the lords and ladies of France. Five years later Queen Elizabeth of England had a coach built for herself. But this coach, although beautifully decorated, was so uncomfortable that the Queen's complaint has come down in history: "I suffer greatly from aching pains in consequence of having been knocked about in a coach driven too fast." Because of this discomfort, the Queen saved her coach for use only on formal occasions. At other times she continued to travel in her sedan chair. In time, coaches were made more comfortable by the use of springs, and transportation by means of wheeled vehicles grew more popular.

Roads. I. Write a paragraph explaining why we can make good use of wheels today.

II. Explain why the Romans built good roads.

III. See whether you can find out where the Roman roads led. You may find a map of the old Roman Empire in a history of Europe of early days.

III. HIGHWAYS, WATERWAYS, AND RAILWAYS

We in the United States are living in a world of steam engines, gas engines, and electric motors. All parts of our country are closely bound together by steel rails, concrete highways, and copper wires — by rapid travel and instant communication. How has our country come to have this kind of civilization?

TRAVEL IN A NEW LAND

When the white men first reached the eastern shores of what is now the United States of America, they found only miles and miles of trackless forests, miles and miles of plains, miles and miles of rivers and lakes; and they found high mountains and low valleys. These lands had never before been used for anything except to provide hunting grounds for the Indians and the wild beasts.

These homeseekers from Europe had grown accustomed to the means of travel and communication which were used in their own countries. But they brought with them to their new land no highly decorated coaches, such as they had used in their native lands. They carried no sedan chairs or palanquins on their ships. They brought no gay

river barges. Instead, they adopted, first of all, the methods of travel and of sending messages used by the Indian natives whom they found here. Thus the earliest colonists in the United States went back a great many years in methods of transportation and communication.

The settlers cut down the trees of the forests and used the timber for building their homes and for making crude boats. They planted the cleared land and raised crops. They dug out the ore from the mines and made tools and weapons and parts of vehicles with it. They used, first of all, the materials which they found in this new country.

For a number of years the settlers continued to stay near the Atlantic seacoast. In fact the great range of the Appalachian Mountains shut them out, like a wall, from the lands beyond. During those early years the settlers depended upon the rivers, streams, and lakes to supply them with highways of travel. These waterways were better than roads, anyway. The Indian trails were the only highways for land travel; so carriages, coaches, and wagons were out of the question. For years and years after the colonists left Europe, transportation was very slow. And since all communication had to depend on the means for transportation, there was little of it, and that little was slow and uncertain.

At first the people of America used only such watercraft as the native Indians had been able to develop — dugouts, rafts, and bark canoes. In such craft

they paddled up and down the streams and across ponds and lakes. The streams along the Atlantic coast are short. They extend westward only to the foothills of the Appalachian Mountains. For years and years that was as far west as most people went, for the means of transportation which they used could take them no farther than the sources of the rivers.

If you will take a map of the United States and trace the rivers along the Atlantic coast to their sources, you will readily see how limited were the early settlers in their highways of travel by water. Look especially at the Merrimack and the Connecticut rivers in New England, at the Hudson River in New York, and at the Delaware, the Susquehanna, and the Potomac rivers at the middle coast region. Even if canoes found it possible to go to the very sources of these streams, you can see that they would not carry people or goods very many miles from the coast into the interior of our country. For many years, however, these coastal streams did serve to provide the settlers with waterways, and crude watercraft of different kinds proved to be the most useful means of transportation.

As more and more settlers came over, and as farmland along the coast became scarce, people grew curious as to what lay on the other side of the Appalachian Mountains. Among the most curious were the hunters, trappers, and woodsmen — those brave trail breakers of the wilderness who led the stream of

people into the West. One of the most famous of these rovers was Daniel Boone, who led a party of settlers through the mountains between North Carolina and Kentucky, by way of the Cumberland Gap. Other groups of pioneers followed him. They found the land beyond the mountains rich and fertile and very, very plentiful.

Farther north, people found their way to western lands through the Mohawk Trail. In a short time the territory which is now western New York and Pennsylvania, as well as Ohio and Kentucky, became dotted with settlements. And as more people moved into the new country, there was more reason than ever for wanting better means of travel.

DEVELOPING OUR WATERWAYS

People began to demand good roads over which to travel to the new lands in the West. They asked the states to build roads. They asked the national government to build roads. In time, the government built the *National Road*, reaching from what is now Cumberland, Maryland, to Indianapolis. It was usually called the *National Pike*. The people of Baltimore, seeing their advantage in this road, built a privately owned road from Baltimore to Cumberland. These two roads made it possible for people from the eastern coast to travel to the West. They made it possible for the East to build up a good trade with the new settlements beyond the mountains.

Baltimore, which was the chief coast city south of the City of New York, grew and prospered by reason of the new trade.

New York was envious of the new road which led from Baltimore. Was Baltimore to become the chief trade port of the coast? Was the City of New York to lose her trade and become a second-rate port? The people of the state became excited. They tried to find some way by which they could keep their trade with the new West. Finally, they did find a way. The state built a waterway — a canal connecting the Hudson River with Lake Erie.

The Erie Canal, as this new waterway was called, was opened in 1825. At the opening ceremony the Governor of New York, DeWitt Clinton, poured a keg of Lake Erie water into the Atlantic Ocean. He did this to impress upon the people the fact that the waters of the Great Lakes could now flow into the Atlantic Ocean. He wished to say that people and goods could travel from the City of New York up the Hudson River to Albany; then by way of the Erie Canal to Buffalo; and then by way of the Great Lakes to all that vast territory which is now Ohio, Indiana, Michigan, Illinois, and Wisconsin. Think what an advantage that was!

New York no longer had reason to be envious of Baltimore. She had a water route which led to the lands beyond the mountains. So great was the rush of trade over this new water route to the West that the Erie Canal paid for itself in nine years.

A CANALBOAT ON THE

The building of the Erie Canal was one of the big steps in the development of transportation in America. It marked the beginning of the period in which the people of America became interested in improving their waterways. At that time road building still seemed an enormous task — the country was so large. It seemed to many that the only means for improving travel was to improve the waterways.

Much building of canals followed. All over the country the people became interested in connecting the streams and rivers by means of canals. Canals were thought of as the links which might be used to connect the whole system of waterways in America. Millions of dollars were spent in digging canals and in building canalboats. It was even proposed that a canal be cut entirely across the United States, connecting the Atlantic and Pacific oceans. People

Culver Service

ERIE CANAL IN EARLY DAYS

traveled by way of the canals. People sent all manner of goods through the canals.

But travel by canal was slow travel. As you probably know, the early canalboat was towed by horses or mules. A team of these animals, driven by boys or men who sat astride them, walked along a towpath at the side of the canal. By means of long ropes attached to the canalboat, the team slowly pulled the boat along the course of the canal. The speed of travel was the gait of a walking horse or mule.

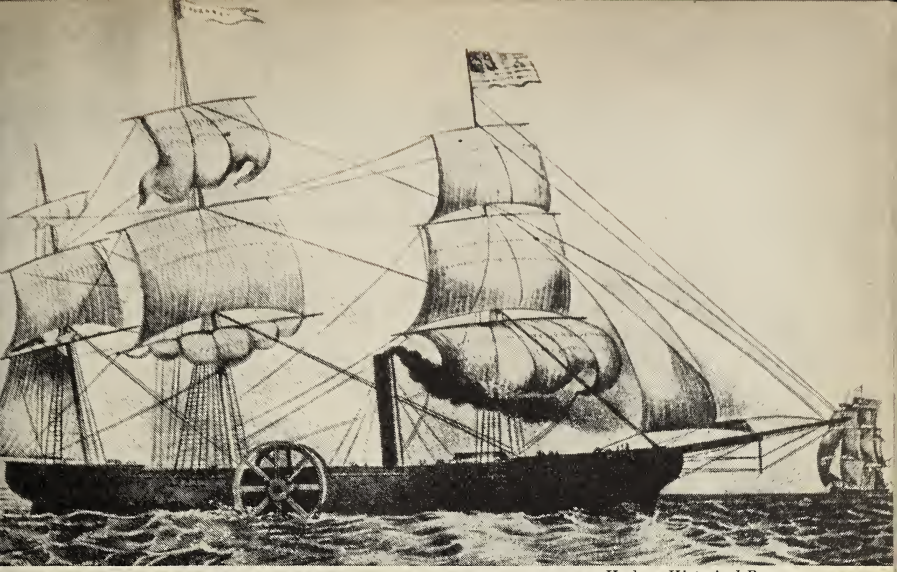
Finally, there was another great change. The steamboat was invented! You may remember that James Watt had invented the steam engine in 1781, in England. But for a good many years after its invention the steam engine was used only for pumping water or for turning the wheels of machines that stood still. Yet, all the time, there were men who

were trying to think of ways of making the steam engine move vehicles. Some of them had been trying to discover a way of moving boats by steam. A few attempts, both in England and in America, had been partly successful. Robert Fulton was the first one in America to make a steamboat which the people would accept.

It is always hard to get new inventions accepted. People like their old ways of doing things too well to give them up easily. When the people saw Robert Fulton's first steamboat, the *Clermont*, moving up the Hudson River in 1807, they peered and gazed and laughed. What was this queer-looking vessel, puffing clouds of black smoke, churning the water into a foam, and moving up the river at the rate of four and a half miles an hour? They thought it a joke!

But, in time, the people had to accept the steamboat. They found out that a steam engine could be made to move a boat more rapidly and more easily than could a team of horses or mules. Steamboats began to ply up and down the larger rivers, and back and forth across our inland lakes.

The *Savannah*, the first American ocean-going steamship, crossed the Atlantic Ocean to England in 1818. Fortunately it was equipped with sails as well as an engine, for the engine ran only seven of the twenty-eight days required for crossing. The lower picture on the opposite page points to the fact that, for at least fifty years, steam did not eclipse the sailboat for ocean travel.



Hudson Historical Bureau

THE *SAVANNAH*, OUR FIRST OCEAN-GOING STEAMSHIP

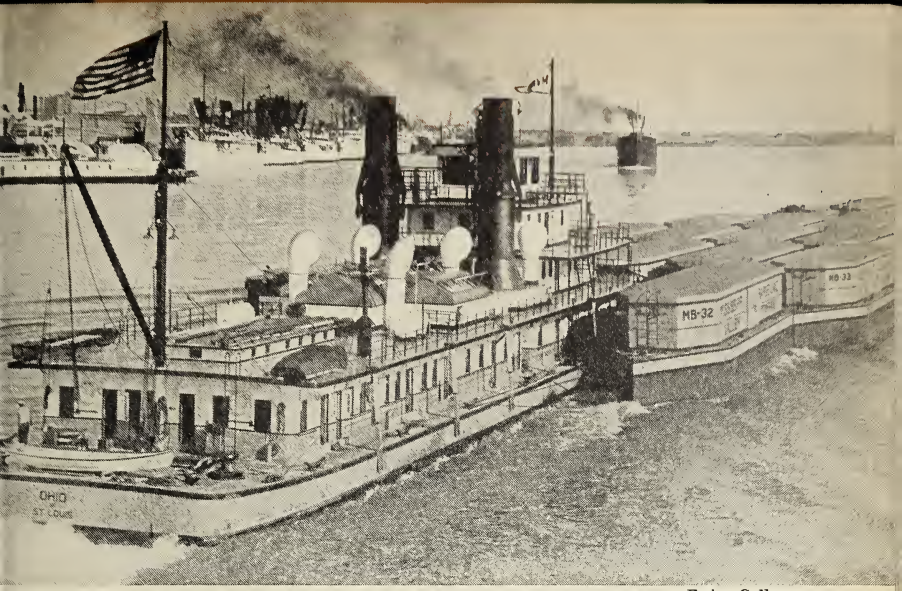
Black Star

SAILING CRAFT IN A NEW YORK DOCK IN 1870

The triumph of the inland waterways was short-lived, however. A rival appeared — the railroad.

The steamboat lines did not want a rival to spoil their business. They fought the railroad companies, but it did no good. In time, the railroads proved that they could move passengers and freight more rapidly than the canals could. Soon most of the canals fell into disuse. Others were used for a few years and then given up. The great dream of the canal builders was over.

There is still important transportation on some of the great waterways of our country, however. The Great Lakes, with their connecting canals, form our biggest inland system of waterways. Grain, ore, and lumber from our North Central states are carried by fleets of huge freighters to Chicago, Cleveland, and other lake ports. More tons of freight pass through the canal of the Sault Sainte Marie and through the Detroit River than through any other inland waterway. The Erie Canal, now called the New York Barge Canal, is still a water-highway leading from this Great Lakes system, and it still brings its yearly quota of grain, lumber, and ore cargoes from the North Central states down to the great port of New York. The Mississippi River with its great tributaries, the Ohio and the Missouri, still has its steamboat traffic, too. Water transportation is cheaper than transportation by rail; and bulky cargoes are often sent by water on long hauls, where speed is not important.

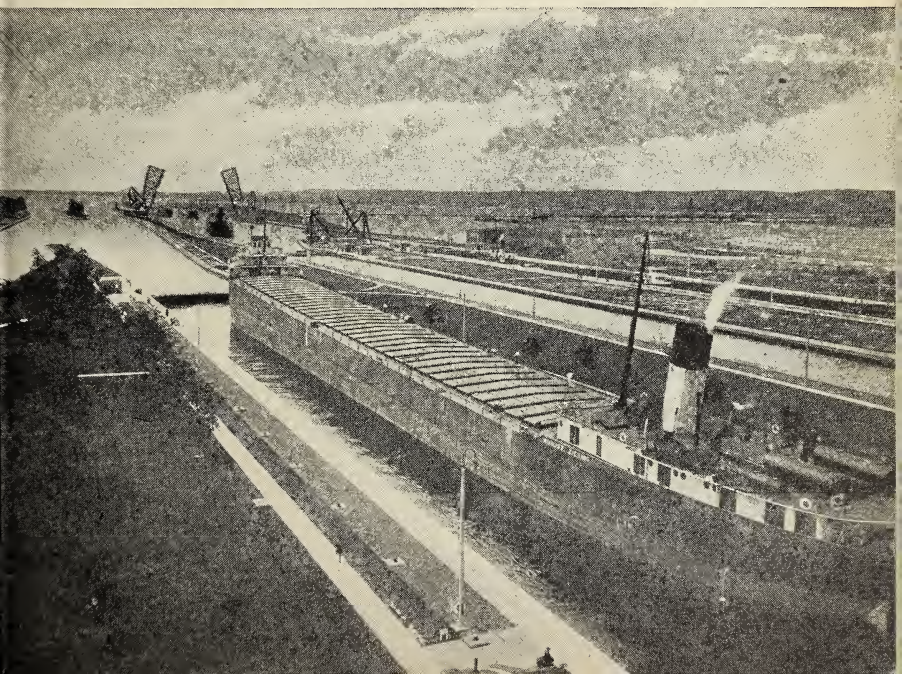


Ewing Galloway

TRAFFIC ON OUR WATERWAYS

Above is a scene on the Mississippi River. The picture below shows freight boats in the locks of the Sault Sainte Marie.

Ewing Galloway



From this story you can see that there were three periods of development of water transportation in America. First, there was the period in which the early settlers depended almost entirely upon the coastal rivers and streams for a means of transportation. In the second period, the waterways were improved and canals were cut through the land to connect the inland rivers and waterways. In the third period, many of the waterways became much less important. In a few favored places, however, such as in the Great Lakes region, water transportation is still important.

Waterways of America. I. Find pictures of early rafts, dugouts, and bark canoes. Study these pictures to see how such watercraft are made.

II. Tell why the rivers and streams were so important to the early settlers. Using a map, find the names of some of the rivers and streams that the colonists used most.

III. Find out how mail was carried in our country before 1800.

IV. Read in your history about Daniel Boone and how he led the people through the Cumberland Gap.

V. Prepare a report for class on one of these topics:

1. The building of the National Road.
2. The building of the Erie Canal.
3. John Fitch and his steamboat.
4. Robert Fulton and his steamboat.
5. Transportation today on our rivers and on the Great Lakes.

Museum of the City of New York

A PRIVATE COACH AND A SEDAN CHAIR IN 1750

IN THE DAYS OF SLOW WHEELS

At the time of the Revolutionary War, which was about one hundred sixty years ago, only a few people had their own carriages and only wealthy people traveled. At that time the stagecoach was the best means of public travel. Stagecoach companies were formed to carry travelers on regular trips, just as the bus lines carry us today. Companies were formed to build roads, too. They collected a *toll*, or tax, from every vehicle traveling on the road, in order to pay for the building and upkeep of the road. As fast as these toll roads were built, the stagecoach routes extended through the East. Later this means of travel extended also through the West.

Culver Service

CARRYING PASSENGERS AND MAIL IN 1850

The roads, however, were very poor, and stage traveling was difficult and uncomfortable. Often the driver would command his passengers to lean out of the windows, first on one side and then on the other, to balance the coach as he drove through the mud holes and over ruts. Often the passengers were compelled to get out and push the coach out of the mud holes. Frequently they were asked to get out of the coach and walk up a steep hill, in order to relieve the horses.

To travel by stage was dangerous as well as difficult. The coach was an easy target for Indian raids and for bold outlaws and highwaymen. Nobody traveled without being armed, and passengers were always expecting an attack of some kind.

From a painting by Darley

CONESTOGA WAGONS ON OUR WESTERN PLAINS

After the Revolutionary War the people of the United States began to move west to get new farms. They traveled in covered wagons, pulled by heavy yokes of oxen or by teams of horses. These vehicles were called Conestoga wagons because they were first made in the Conestoga Valley in Pennsylvania. The Conestoga wagons traveled in groups. Sometimes more than a hundred traveled in one caravan.

The Conestoga wagon was built so that it could be used as the family living quarters and as a traveling vehicle at the same time. A tool chest and buckets hung on the outside of the wagon. On the inside were kitchen utensils, dishes, food, bedding, furniture, and clothing for the family. The wagons were painted red and blue.

Ewing Galloway

A DIRT ROAD OF HORSE-TRAVEL DAYS

Sometimes the Conestoga wagon had to be floated over swollen streams. For this reason, the bottom of the wagon was made watertight and was often shaped like a boat, with a high prow.

The family often sat on the floor of the wagon. The wagon was without springs, and the roads were rough. Bump! Bump! How uncomfortable it was! How tired the travelers must have been!

Most of the country roads were just dirt roads, full of holes and deep ruts, although the farmers tried to keep them smooth. The streets in the towns were little better, for few streets were paved.

Hudson Historical Bureau

HORSE-DRAWN VEHICLES ON CITY STREETS

About a hundred years ago road building began to improve, and people began to improve the horse-drawn vehicles, making them more useful. Carriages were so much improved by skilled craftsmen that they became more comfortable and more beautiful. Fine horses became important, and people who could afford to do so owned carriages and horses. People liked to drive horses that were slender and swift, and often they tried to match the horses in a team so that they would look well together. Indeed, driving a well-matched team of horses hitched to a good-looking carriage became a sign that one was well off.

Hudson Historical Bureau

A TEAM OF FINE CARRIAGE HORSES

But horse travel was not altogether satisfactory. The horses tired easily and were expensive to feed. They traveled too slowly. Up to a hundred years ago people had no swifter means of travel than had the old Romans two thousand years ago.

In the Days of Slow Wheels. I. Describe the dangers of travel during stagecoach days. Make pictures showing some of these dangers.

II. Write a paragraph explaining why people seldom went to distant places for pleasure a hundred years ago.

III. Find out why people went west after the Revolutionary War and what was the result of this movement of people into western lands.

THE BEGINNING OF RAILROADS

The story of railroads begins in England. As far back as 1610, the miners of Newcastle, England, laid down rails in their coal mines. They used these rails for moving coal cars out of the mines. At first the rails were wooden planks laid down on the floor of the mine. Then the planks were placed on crosswise pieces of wood like the crossties of today. Next the wooden rails were made narrow and coated with thin sheets of iron. Finally iron rails were used, and iron wheels were placed on the cars. By 1750 there was hardly an important mine in England that did not have its railroad. Sometimes boys or women pushed the cars piled high with coal, and sometimes the cars were drawn by horses, donkeys, or dogs.

But tracks and cars were only the beginning of the railroad idea. What about the engine to pull the cars?

For a few years after James Watt had made his improved steam engine, the engines were stationary; that is, they stood still while they produced power. Finally, however, men began to think of ways of putting the steam engine on wheels. Several people tried to do this, but none of their engines worked very well.

In 1825 George Stephenson, an Englishman, built an engine which was able to move itself and eight loaded cars. He called this engine a *locomotive*. It was able to travel at the rate of four miles an hour.

You would think that the people of Europe and America would have built railroads and made locomotives as fast as they could after that. But they did nothing of the sort. People did not have faith in the locomotive. They did not think it would work. They did not think it was safe. And they thought that building locomotives would cost too much money. Besides, many people felt that locomotives were not needed. "Have we not our waterways?" they said. "Have we not our highways? Why do we need those dirty, noisy locomotives?"

People did not think the railroad practical, either. What would keep the rails from being washed away in a rain? What would keep them from being buried in a snowstorm? How could the engine take curves? The noise would scare the horses and keep the hens from laying. The smoke would make the sheep's wool black. Sparks would set the fields on fire.

The early railroads met with more favor in England than they did in the United States. The people of England began to see that railroads could play a large part in solving their transportation problems.

However, the people of our country were anxious to improve their means of transportation. The prosperity of the farmers depended upon better means of marketing their products and of getting machinery to their farms. The prosperity of city people depended upon getting raw materials to their mills and the manufactured products to wide markets. Communication depended upon transportation.

Courtesy Baltimore and Ohio Railroad Company

A BALTIMORE AND OHIO HORSE-DRAWN RAIL CAR

Every message which was sent or received had to be carried by man, beast, or boat. The success of the government depended upon more rapid communication, for the great distances between the various parts of the country were dividing the people. The movement of troops in time of war and even the safety of the people might depend upon quick communication.

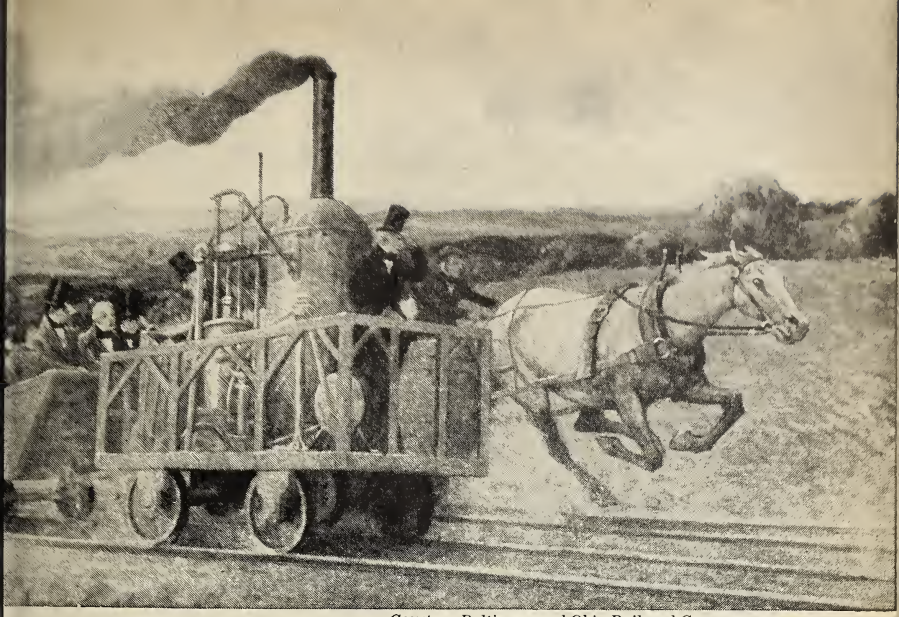
There were a few men, therefore, who saw the possibilities in the railroad. One of them was Peter Cooper, a New Yorker who owned property in Baltimore. He wanted to see Baltimore become a wealthy city. He helped some of the people of Baltimore build a railroad called the *Baltimore and Ohio Railroad,* on which they had expected to use horses to pull the cars.

This idea did not suit Peter Cooper. He wanted to try the locomotive. Finally, he engaged a carriage maker to fashion him a little locomotive weighing only three and a half tons. Then he persuaded the owners of the railroad to let him try his engine on their road.

The day of the trial came. It was August 28, 1830. Crowds of people dressed in their best clothes were gathered to see the tryout. Flags were flying. Whistles were blowing. People were excited. It was a great occasion. It was the first time an American train had been moved by an American-made engine.

Peter Cooper stood on the platform of the little *Tom Thumb* with his hand on the throttle. His passengers, the directors of the Baltimore and Ohio Railroad and their friends, were seated in a car behind the engine. The fireman was feeding pine knots into the firebox, and thick smoke and sparks flew out of the smokestack. Peter Cooper opened the throttle. The wheels began to move. The *Tom Thumb* started with a jerk. The directors lurched in their seats. Sparks lit on their hats and clothes and faces. The *Tom Thumb* began its thirteen-mile run from Baltimore.

The train moved on. Peter Cooper pulled the cord, and the engine whistled. It puffed and thundered. All went well until a driver of a horse-drawn coach, worried for fear the railroad would take away his business, started a race. Down the



Courtesy Baltimore and Ohio Railroad Company

THE RACE

The old gray mare paces the *Tom Thumb.*

tracks sped the *Tom Thumb.* Down the road sped the coach and the gray mare. Faster and faster they went. Then — bang! The *Tom Thumb* came to grief.

We like to believe that the gray mare would never have won that race if it had not been for a broken belt on the *Tom Thumb.* We like to believe that the little engine belonging to Peter Cooper was swift enough to have beaten an old gray mare. But the boiler was small. There were old musket barrels for flues. The little *Tom Thumb* could travel not quite eleven miles an hour. Peter Cooper had put up the best fight he could, and yet the gray mare did win the race.

Losing the race with the old gray mare did not put an end to the locomotive, however. Indeed, the trip of the *Tom Thumb* was good advertising for Peter Cooper. People became interested in the newfangled idea of transportation. They talked about it. They laughed about it. In time, they came to believe in it and to accept it.

The next year another railroad system, the New York Central, one of our greatest systems today, was born. The first train on this system was called the *DeWitt Clinton.* These two railroad lines, the Baltimore and Ohio Railroad and the New York Central System, had an important part in the railroad history of our country.

Railroad Beginnings. I. Find out about the improvements in the steam engine made by George Stephenson.

II. Find and read the whole story of Peter Cooper and the first American-made locomotive.

BUILDING THE RAILROADS OF THE UNITED STATES

The early railroad lines in the United States were short and built to serve small areas. Each line was built by an individual or by a small company. Standard parts for railroads were not being manufactured at that time. And so each of the railroad builders followed out his own ideas as to how to build a good railroad, and each railroad line was built to serve the transportation needs of its own locality.

For these reasons, the early railroads were not all alike. The rails of one railroad line might be far apart; the rails of another, quite near together. The engines and cars of one railroad line would differ in width from those of other lines, for their wheels were made to fit their own tracks.

With these separate railroad systems passengers could not travel long distances on one train. A person traveling from Albany, New York, to Chicago, Illinois, had to buy eight different tickets. He had to ride on eight different railroad lines. In addition, he had to change trains whenever the train came to a river, for there were few bridges strong enough to hold trains. People had to get out and walk across the rivers on footbridges.

Sending freight long distances was difficult, too. Freight cars from different lines could not be attached or coupled together. A carload of freight had to be unloaded at the end of one railroad line. Then it had to be reloaded into the cars of the next line. Freight had to be carried across the rivers in boats or by men on footbridges. These things made shipment by freight very expensive.

While railroads in the East were trying to overcome their difficulties, railroads in the West were just beginning to be built. To encourage them, the government gave their builders grants of land. In return the railroads, when built, were to carry the mail, munitions, and United States troops at a low cost to the government.

The government land grants made it possible for railroad companies to lay tracks in the West. A company called the Central Pacific began to build a railroad line eastward from San Francisco. A year later, the Union Pacific began a line westward from the Missouri River near Omaha, Nebraska.

The companies which undertook the building of these railroads and the men who worked at laying the tracks were pioneers in solving the transportation problems of our country. No one knew whether the railroads would pay for themselves or not. The workers never knew when wild animals or Indians might attack them. Gangs of men worked with shovels in their hands and guns on their backs.

The two lines of track met at Promontory Point, near the head of the Great Salt Lake in Utah, on May 10, 1869. A ceremony was planned, and representatives from each company were present, in order to watch the joining of the two divisions of the road. A golden spike was driven into a mahogany crosstie to unite the two parts. It was a great occasion for the people of the United States. The new continuous line made railroad travel from coast to coast possible.

Soon after, other railroads were laid across the western plains and deserts and through the mountains. A railroad was laid north to Portland, Oregon, and south to Texas. If you will look at the railroad map on page 188, you will see that a network of railroads covers our country today.

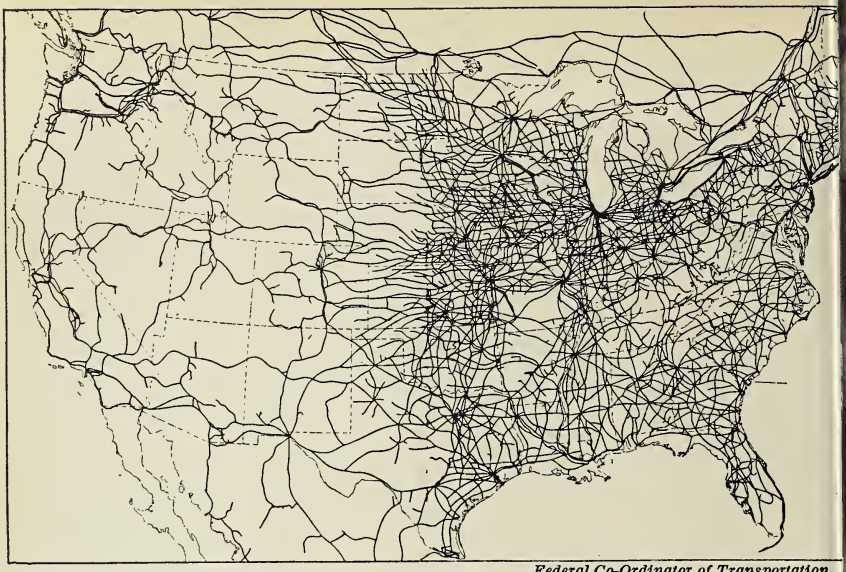
Hudson Historical Bureau

THE CEREMONY OF THE GOLDEN SPIKE

An artist, Thomas Hill, has painted a picture of the ceremony. A reproduction of his painting is shown above.

Our railway systems today provide comfortable and rapid travel service for passengers. Business and pleasure trips ranging anywhere from a few miles to several thousand miles are possible to many people. Improved safety devices make our railway travel safe. Dining cars, sleeping cars, and lounging cars make our travel luxurious.

The railroad systems have had a big part in making the United States one of the greatest industrial nations of the world. Rapid transportation has made it possible for factories to spring up all over the land. Let us see why.



Federal Co-Ordinator of Transportation

PASSENGER RAILWAY ROUTES

Factories need raw materials — minerals, cotton, wool, sand, wood, grain. These raw materials come from various parts of the United States and from other countries. Thousands of miles of tracks and thousands of freight cars are necessary to move these materials from the places where they are produced to the places where they are made into useful articles.

Factories need a market for their goods. Our railway systems are needed to move the manufactured articles from the factories to the places where they are to be used.

Factories need people to do the work. People have moved from the farms and the small towns into the cities where the factories are located. Without the railroads the cities would find it hard to supply the people with the things they need.

Courtesy Northern Pacific Railway

COMFORTS OF RAILWAY TRAVEL TODAY

Comfortable chairs and well-equipped dining cars add to the pleasure and convenience of present-day travel.

Courtesy Northern Pacific Railway

Business people are dependent upon rapid communication. They send and receive many letters and parcels each day. They send instructions to members of their firm who work in localities far from the main office. They write for information about the kinds and prices of raw materials they wish to purchase. They advertise their products with circulars. They send samples of their goods and other small packages by mail.

The railroads of the United States have been the chief carriers of the mails for many years. They have tried to work out a system in which no time is wasted. Mail is sorted in mail cars on the trains. It is put into different bags, and each bag is locked securely. When the mail train passes a town, the proper bags are thrown off on the station platform. From there, they are taken in trucks to the near-by post offices. The mail train goes ahead of other trains. It does not wait for late mail or late newspapers. Faster and faster has this service become until today the railroad can carry mail across the country from New York to California in four days. Seventy-five years ago it took twenty-eight days for mail to make this trip.

Today much freight is being hauled by trucks. Some of the mail is being carried by airplane. But the railroads are still carrying most of the freight and most of the mail, just as they did for years before we had these other ways of carrying on the business of the nation.

H. Armstrong Roberts

A COMMON SCENE IN FREIGHTYARDS

Throughout our land, scenes like the one above show us the important place of freight traffic in our daily living.

Roadways of Steel. I. Study the railway map on page 188. Where are the most railway lines? In what states? Near what cities? Use your geography to find out.

II. Write a paragraph telling why the government thought it wise to give land to the railroads.

III. Find and read the whole story of the building of the Union Pacific Railroad. Why was it such an important event? What changes did it bring to America?

IV. Explain how the railroads help business people.

Reading about Railroads and Ships. Steam has played an important part in helping to solve man's transportation problems. In the books listed below, you will find interesting stories about steamboats and steam trains:

Ships of the Seven Seas by Hawthorne Daniel

The Ship Book by Jean H. Dukelow and Hanson Hart Webster

Historic Railroads and *Historic Ships* by Rupert Sargent Holland

Trains, Tracks, and Travel by T. W. Van Metre

Some Mail Carriers. I. Look through the books in your bibliography for stories about the Pony Express. Write a paragraph telling whether you would like to have been a Pony Express rider if you had lived in 1860.

II. Find out how many letters are handled by your local post office each day. Your local postmaster will probably give you this information. Ask him how many of these letters are usually carried by railroads; how many of them are usually carried by airplanes.

IV. COMMUNITY TRAVEL

In our country we are accustomed to much travel. Sometimes we take long trips, on ships or trains or airplanes. But more often our trips are short, daily trips for business or for pleasure. What kinds of vehicles do we use for daily travel?

ROAD SPEED

Perhaps you have read the story of Alice's adventures as told in *Through the Looking Glass*. You may remember how the Red Queen took Alice for a fast run through the garden of the live flowers. Alice had been talking with the Red Queen on the hill when suddenly:

. . . . they were running hand in hand, and the Queen went so fast that it was all she could do to keep up with her: and still the Queen kept crying, "Faster! Faster!" . . . . and dragged her along.

"Are we nearly there?" Alice managed to pant out at last.

"Nearly there!" the Queen repeated. "Why, we passed it ten minutes ago!" . . . .

"Now! Now!" cried the Queen. "Faster! Faster!" And they went so fast that at last they seemed to skim through the air, hardly touching the ground with their

feet, till suddenly, just as Alice was getting quite exhausted, they stopped, and she found herself sitting on the ground, breathless and giddy. . . . .

Alice looked around her in great surprise. "Why, I do believe we've been under this tree the whole time! Everything's just as it was!"

"Of course it is," said the Queen. "What would you have it?"

"Well, in *our* country," said Alice, still panting a little, "you'd generally get to somewhere else — if you ran very fast for a long time as we've been doing."

"A slow sort of country!" said the Queen. "Now *here*, you see, it takes all the running *you* can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!"

About forty years ago, people were beginning to feel just as Alice felt — that they were staying too long under the same tree. Although fast steamships were crossing the ocean, although steamboats were chugging up and down the rivers, and although steam trains were puffing up and down the land, the people kept shouting, "Faster! Faster!"

Steamboats and trains were all right for long trips. But how about short trips out in the country? How about Father's trip to the office or factory? How about Mother's shopping trips? How about a family ride for pleasure in the evening? In spite of the progress in ways of travel which had taken place in the past few years, people were just where they had been for centuries when it came to short trips about

home. The very best that a family could do was to harness old dobbin to the buggy and drive him along the cobbled streets and over the rough highways. But the horse and carriage were too slow.

After the steam locomotive was used, some people thought steam-driven carriages might be used on the highways. A number of people tried to invent steam-driven carriages, but they found that the steam engine was too heavy for road travel. It needed too much fuel, too. There was no way of carrying heavy wood or coal in a small vehicle. Inventors tried several ways of overcoming these difficulties, but nothing important came of their efforts.

Men did not give up trying, however. They wanted a horseless carriage. They needed a faster method of travel on the highways. They tried this method, and they tried that method. They tried to use steam power. They tried to use wind power. They tried to use the new electric power which was so successful in communication. But the vehicles they invented were not successful. And then finally — of course you know something must have happened! Whenever people want anything very much, they usually find a way of getting it.

One day the people of the world were startled by the news of the invention of a new engine. It was the gas engine. What did this mean? It meant that man had learned to make power by the explosion of gas in a cylinder. It meant that men now had a way of making a powerful engine much smaller in size

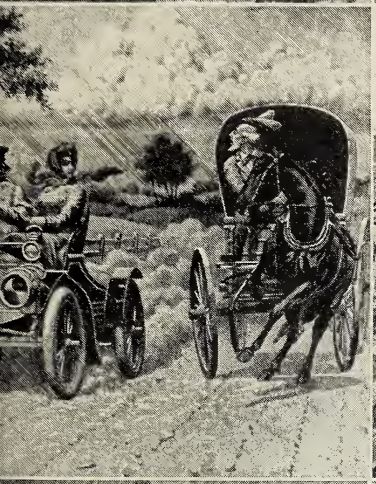
than the steam engine. It meant that gasoline could be used for fuel. It meant that, finally, people were to have an engine for driving a carriage.

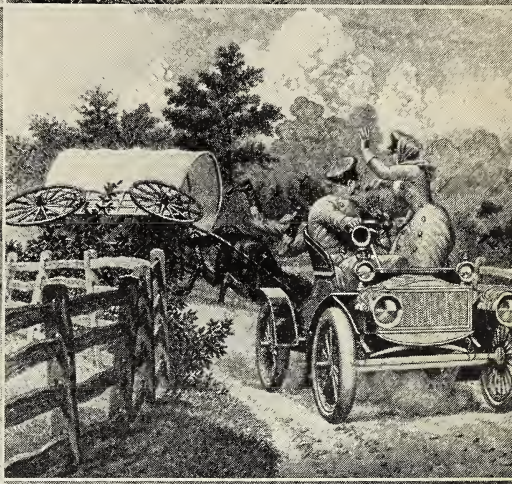
The inventors went to work in earnest now. So many of them worked on this problem of inventing a *horseless carriage* that it is hard to say who made the first one. Perhaps we should say many people made it. At any rate, we must remember that the first one was not made in America. The French, the Germans, and the Austrians probably did most toward making the first automobiles. Later, America did her share in improving them.

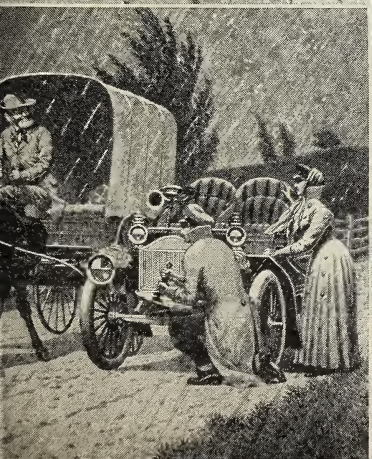
The first automobile was truly a horseless carriage. People found it impossible to think of this new vehicle in any other way. They built it to look as much like a buggy as possible. Indeed, the idea was so strong with the first automobile makers that they even provided a place to carry a whip. It was hard to give up the idea of a horseless carriage.

People made fun of the first automobiles. They were afraid of them, too. The pictures on the opposite page show a series of cartoons designed to ridicule the early automobile. But many people wanted the automobile so badly that before long it was being used for travel in the community. In a few years thousands of automobiles were in use, and by 1920 millions of automobiles were moving over the highways.

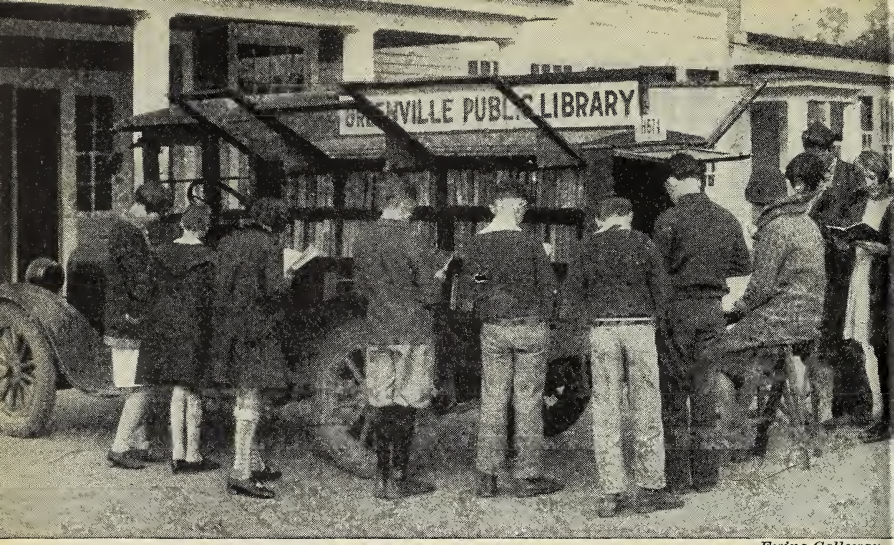
Credit note: The pictures on page 197 were drawn by Joseph Boggs Beale and are reproduced through the courtesy of the Ford Motor Company.







2302



Ewing Galloway

THE MOTOR LIBRARY BUS SERVES THE COMMUNITY

Ewing Galloway

THE MOTOR SCHOOL BUS SERVES THE COMMUNITY

Today there is one automobile for every five people living in the United States. That means that all the families in the United States could go riding in motor vehicles at the same time.

The automobile brought good roads to America. The old dirt roads were not good enough. Every family that bought a new automobile became a booster for better roads. Miles and miles of *hard-surfaced* roads were built. Today we have thousands of miles of highway suited to automobile travel.

Road Speed. I. Explain why people first called the automobile a *horseless carriage.* Explain why it was hard to give up the idea of a horseless carriage.

II. Find out about the invention of the gas engine. Why was it such an important event? Explain how the gas engine made the automobile possible.

III. Find pictures of early automobiles. Plan to show these pictures to the class and tell interesting facts about how people traveled in the earliest automobiles.

IV. Write a paragraph telling how the automobile has changed the travel habits of the people of the United States.

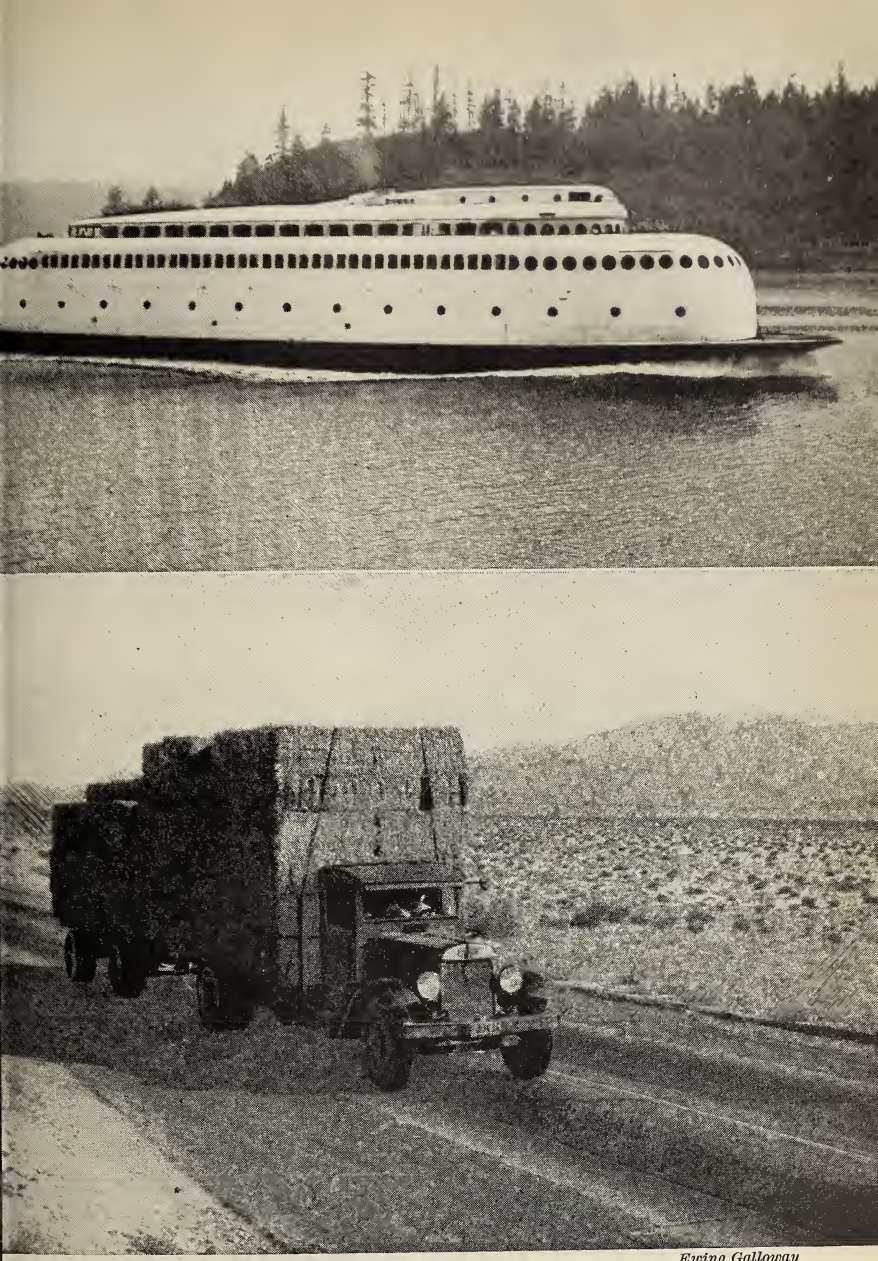
V. Ask your neighborhood service station for a highway map of the United States. One or two maps should be enough for the entire class. With your finger, trace on your map the shortest route you might follow to some distant city. Start from the town or city in which your school is located. How much of the road is improved? How much is dirt? How much is under construction?

PUBLIC CONVEYANCES

Many people in our country find it convenient to buy rides on public vehicles. Some ride in trolley cars. Some ride in busses. Some ride on subways or elevated trains. Some ride in taxis or on ferries. Most people use all of these kinds of public vehicles at some time. Usually our rides on public vehicles are short ones and cost very little. Public vehicles are sometimes called *common carriers.*

Public vehicles may be owned by the city, or they may be owned by private companies. The city or state has some control over those which are privately owned. A city or state government may make regulations concerning the amount of fare to be paid, the number of people that can be carried at one time, the method of loading and unloading passengers, the behavior of the passengers while they are in the vehicle, the comforts and conveniences they are entitled to, the duties of the attendants, and the route to be followed.

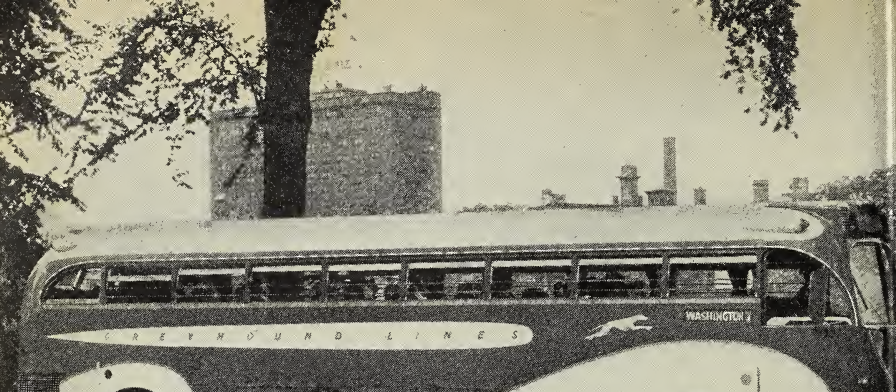
Usually a company that wishes to operate a system of public vehicles is granted permission to use certain streets and roads of the community. This permission is written, and all the regulations are written into it. Such an agreement is called a *franchise.* The franchise may be granted for a long period of time or for a short period. A franchise can be taken away from the transportation company if its members do not live up to their agreement.



Ewing Galloway

CARRIERS IN CONSTANT USE TODAY

The ferryboat and the motor truck play a large part in transporting people and goods.



Courtesy Greyhound Management Company

THE MOTOR BUS FOR PASSENGER TRAFFIC

Public vehicles are run for the convenience of the passengers. Usually they follow certain routes and keep certain time schedules. It is the duty of the company to furnish vehicles enough to accommodate the people who ride. The company is supposed to care for the travel needs of its passengers. Cars and busses must be heated in cold weather. Toilet facilities and drinking water must be provided if the trips are long. If these conveniences cannot be furnished, the company must require the vehicle to stop at stations at stated intervals.

Some public vehicles, such as subways, ferries, and elevated railways, start their trips from stations. The passengers go to the station to buy their tickets and to enter the conveyance. Other vehicles travel over a route, picking up passengers along the way.

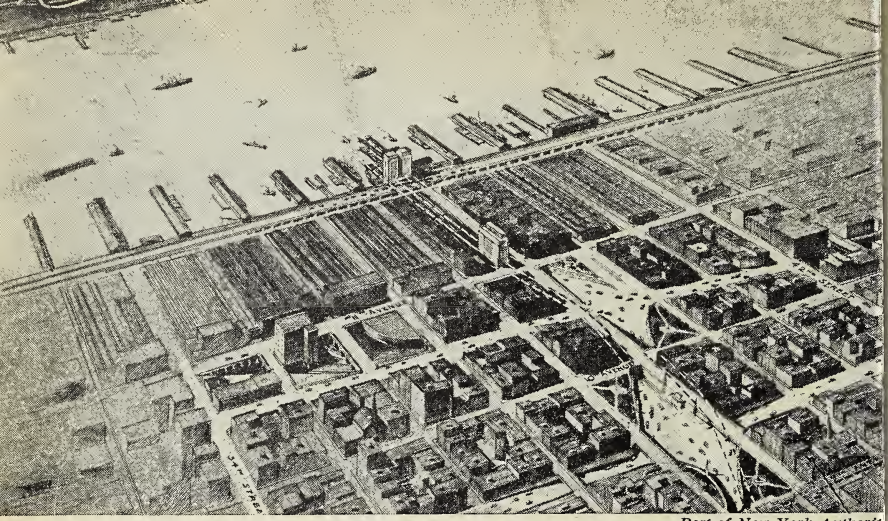
Courtesy Federal Co-Ordinator of Transportation

MOTOR BUS HIGHWAYS

City trolley cars, taxis, and busses pick up their passengers at the street corners. Public vehicles which travel between towns and cities are called *interurban* vehicles. Interurban busses and interurban trolley cars take on passengers only at stations in the towns or at stated stops between towns.

Many improvements have been made in late years in public conveyances. The seats have been made more comfortable. The vehicles are better lighted and heated and have air-filled rubber tires. More safety devices are used. Time schedules are better. The vehicles have been made heavier and do not bounce about so easily. They are larger, and people are not so crowded as they once were.

The map above shows the great extent to which the motor bus is used for travel today.

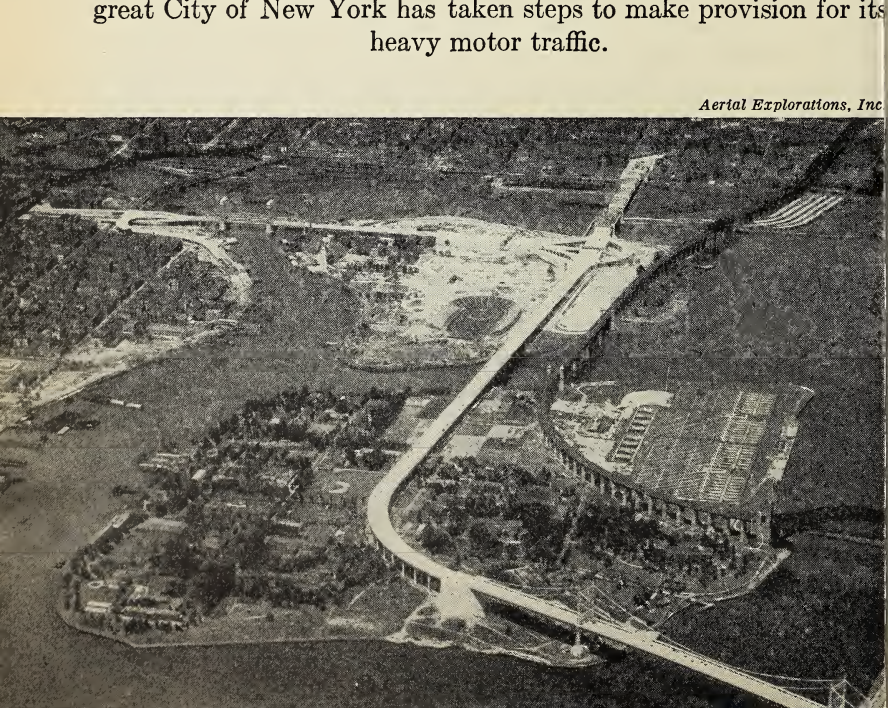


Port of New York Authority

PROVISIONS FOR HEAVY MOTOR TRAFFIC

The tunnel, which is indicated in the picture above, and the Triborough Bridge, which is in the picture below, show how the great City of New York has taken steps to make provision for its heavy motor traffic.

Aerial Explorations, Inc.



Many communities in America, especially the largest cities, have not yet solved their problems of public transportation. The transportation companies have not furnished enough vehicles to care for all the people who wish to ride. This is particularly true mornings and late afternoons when the city crowds are going to and coming from work. These hours are known as *peak hours* in travel. During the peak hours of the morning, traffic is carrying people into the center of the city. At that time the vehicles traveling toward the center of the town are crowded, and riding is most uncomfortable. But the vehicles going toward the rim of the city are empty. During the peak hours of the late afternoon the opposite is true. The vehicles moving toward the center of the city are empty, and those going out are crowded.

Peak hours are troublesome hours for the transportation workers. They are times of inconvenience for the passengers. But it is during the peak hours that the transportation companies make their greatest profit. Yet these peak hours make it necessary for the companies to own more cars than they need during the rest of the day and night. That means that part of the equipment of transportation companies has to stand idle during a part of each day and each night. Communities are in constant conflict with transportation companies on this point. The people want more vehicles at their disposal at the time they need them. Transportation companies complain that supplying enough vehicles for peak

hours makes it impossible for them to make a reasonable profit.

Transportation companies are responsible for the safety of their passengers. In case of accident they are held responsible, unless it can be proved that the passenger was careless or at fault. This regulation has resulted in a better selection of drivers. Transportation companies cannot afford to hire men who are careless or who do not know how to operate their vehicles.

Community Travel. I. Make a transportation study of your community. (1) On a map of your town and county trace the routes of all the public transportation lines, naming the lines. (2) Try to secure figures telling how many passengers travel on each line during an ordinary weekday. (3) Try to find out whether the public transportation problem of your community has been solved. (4) Find out how many private automobiles there are in your community.

II. List the various kinds of community transportation vehicles your family ordinarily uses. Check those which may be called public conveyances.

III. Make a list of safety devices which are used on public conveyances. Select one, find out how it operates, and learn something of its history.

V. TRANSPORTATION THROUGH THE AIR

Men have learned to travel through the air with much the same ease with which they travel on land or sea. The story of this achievement is one of exciting adventure. But it is more than that. The story of flying is the story of dreams come true. It is the story of patient experiment and much sacrifice.

THE FIRST AIRSHIPS

For centuries man struggled with the problem of flight through the air. This problem was much more difficult than any problem man had yet undertaken. But the desire to fly was strong. All through the ages we hear the echo of this great desire. We find it mentioned over and over in the stories men have told. We find it expressed in the pictures which they have made. We have records that tell of how men of earlier times have made plans and experiments by means of which they hoped their wish to fly might come true. But wish as they did, and try as they did, for many, many years men could not quite get the trick of flying like a bird.

There were three problems of flying that man had to solve. The first problem was the problem of just staying in the air — of floating. The second

was the problem of materials — of construction — of how to make a vehicle that would be light enough to float. The third problem was the problem of steering — of being able to move definitely from one point to another, just as the bird does. How were these three problems solved?

There was one man who thought about this matter of flying. His name was Francesco de Lana, and he lived in Italy nearly three hundred years ago. "After all," said the wise one, "it is not flying-like-a-bird that is important. It is traveling-through-the-air that we really want. Perhaps man's way of traveling through the air is not the bird's way."

The idea of Lana was a good one. He believed that an airship might be made to float in the air as a boat floats on the water. The problem was to build an airship lighter than air, so that the air would hold it up.

Lana did not really build an airship. But he made a drawing, showing how he thought one might be built. First, there was to be a boat in which the pilot would sit. To this boat would be attached four large, hollow, copper balls from which the air had been pumped. These globes would be so light that the air around them would hold them up, and they, in turn, would hold up the boat. The wind currents, pressing on a sail fastened to the boat, would drive the ship through the air. Lana seems to have been the first to think of making a lighter-than-air machine. The idea amounted to nothing

in his time. But later, this same idea was used in making the balloon and the dirigible.

A hundred years went by. In 1783 two brothers — Frenchmen by the names of Jacques and Joseph Montgolfier — made two discoveries. They found that a paper bag filled with heated air will rise and float away, but that the bag will stay up in the air only as long as the air remains hot. These were important discoveries, and they made it possible for the Montgolfier brothers to build a balloon that, filled with heated air, would float in the air for some minutes.

At that time it was feared that a human being might not be able to breathe high above the surface of the earth where the air contains less oxygen. So the first passengers ever to ride in an airship were a sheep, a rooster, and a duck. The Montgolfier balloon, with these strange passengers, rose to a height of 1500 feet and floated for a distance of two miles, taking eight minutes for the trip. Because the animal passengers survived the trip unharmed, two men tried going up in a balloon. They rode over Paris and landed in a field outside the city, their balloon rising to a height of 500 feet and the trip lasting twenty minutes. The balloon which accomplished this feat was kept filled with heated air by a fire burning in a brazier that was hanging under the balloon. What a victory this was! Man had truly taken his first step in learning to travel through the air!

People continued to work on this idea of making a balloon or airship which would float through the air because it was lighter than air. But the attempt to make lighter-than-air craft brought many new problems. Men were slow in solving them, too.

First, there was the problem of finding something to take the place of the heated air with which they filled the bags of balloons. In time, men discovered that they could use a gas called *hydrogen.* While hydrogen is far better than hot air for inflating balloons, it is dangerous because it burns easily. In recent times men have discovered another lightweight gas, called *helium,* which will not burn. It is therefore a good gas for balloons or airships. But it is expensive because it is not plentiful. The United States is the only country in which a supply of helium has been discovered. Perhaps men will some day find a gas which will be both safe and cheap. Then we can hope to have airship travel that is less expensive and less dangerous than it is today.

The second problem was that of finding the right kinds of materials from which to make airships. An airship has two main parts — the *balloon* or bag, and the *gondola* or passenger car. Each of these parts must be made of materials which are light and yet strong, but which can be bent and molded into exact shapes. They must be materials which are fire-resisting and which will not attract the electricity from the air. The bag must be made from something very light, yet strong enough to keep the

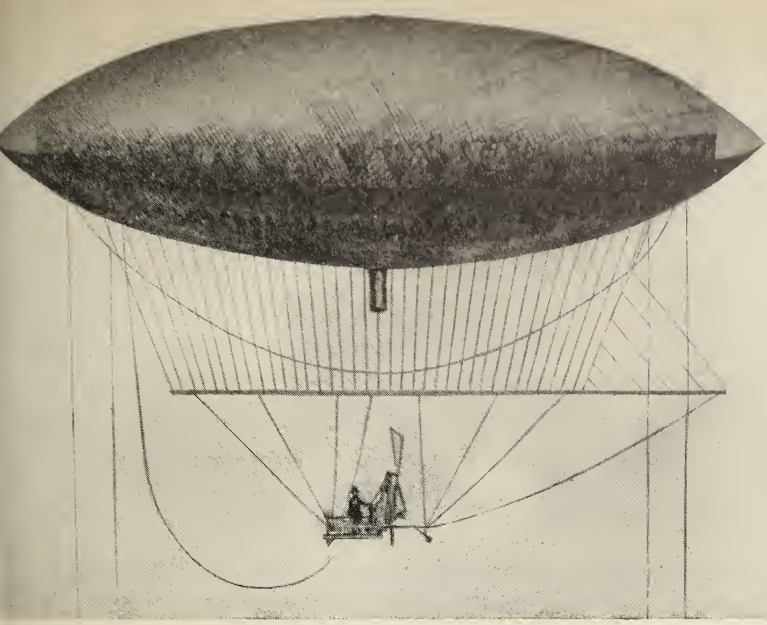
gas from escaping. Men have found these materials. Airships of today are marvels of endurance, strength, lightness, and steadiness.

The next problem was that of construction. How could airships be made from these light materials, yet be strong enough to weather the storms? How could they be shaped so that they would glide through the air easily and swiftly? How could they be made so that there would be room for an operating crew, a large amount of ballast, and passengers?

The most difficult problem of all, however, was that of finding a way to steer an airship. Long after balloons were successfully made, they were still at the mercy of the winds. There was no way to steer them.

In spite of this difficulty, men hoped, as recently as sixty years ago, to be able to cross the Atlantic Ocean from America to Europe by balloon. They hoped to have the aid of the winds, which usually blow from west to east. But the hope was never realized. A little before that time, in 1859, a balloon did sail a thousand miles from St. Louis, Missouri, to Henderson, New York. In Europe a French balloonist traveled 1193 miles from Paris to Russia. But these trips remain the longest balloon flights on record. The three-thousand-mile Atlantic crossing was never made.

Finally Henri Giffard, of France, made an airship that was equipped with a small steam engine. For the first time an airship could be made to travel in



Brown Brothers

THE GIFFARD AIRSHIP

the direction and at the rate decided upon by the pilot. The steam engine was not practical, however, for airship travel. It was too heavy. It needed too much fuel. The problem was not yet solved.

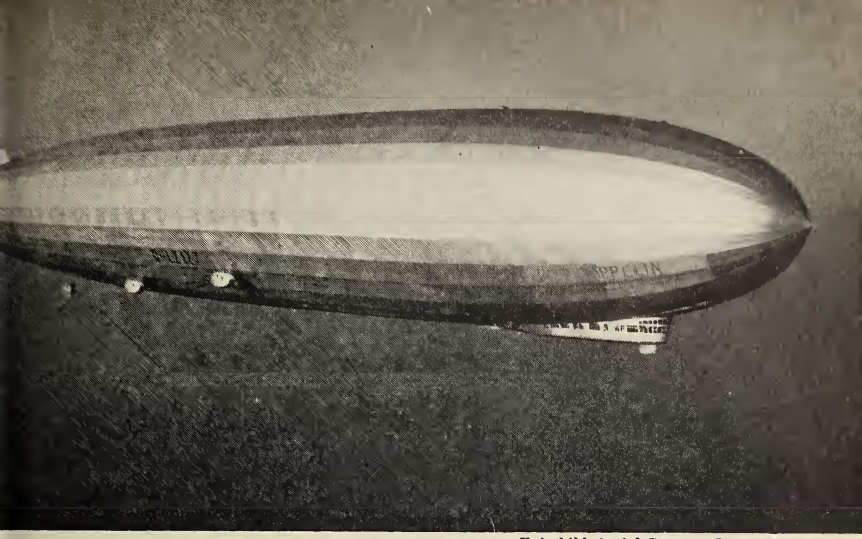
Then came the invention of the gas engine. That solved the biggest problem of air travel. The gas engine is small. For fuel it uses gasoline, which is easily carried. The gas engine is safer for airship travel, too, for there is less danger of such an engine's setting fire to the hydrogen in the gas chambers.

Many people continued to experiment to improve the airship. Among them were Alberto Santos-Dumont, a Brazilian who worked in France, and Count Ferdinand von Zeppelin, a German. Count Zeppelin probably did more than any other man for

the improvement of the airship's construction. Instead of using a gas bag of silk which would collapse when the gas escaped, he constructed an oval aluminum framework and stretched the strong silk and linen bag over it. Such a noncollapsible bag is called a rigid bag. Count Zeppelin divided the rigid framework into compartments. In each compartment was a small gas bag filled with hydrogen. If one of the smaller bags were punctured, only the gas in that one bag would escape. Count Zeppelin made the most perfect airships that had ever been constructed — streamlined, well balanced, large, safe, and comfortable for travel. He also perfected the steering apparatus, and his huge ship was the first successful *dirigible,* or an airship that can be steered.

The *Graf Zeppelin* was the first of the great German dirigibles to prove its success. It made a voyage to the United States in 1928, carrying a crew of forty, twenty passengers, and shipments of freight and mail. It battled with storms over the Atlantic Ocean but came through with only a damaged fin. Upon its return to Germany it had traveled 6300 miles and had remained in the air 112 hours.

When Count Zeppelin's *Hindenburg* was built, it was the largest dirigible that had ever been made. It took its first trip to America in the spring of 1936. It made the trip back from Lakehurst, New Jersey, to Germany in 45 hours, carrying 120 people. That was the shortest time in which so large a group of passengers had ever crossed the ocean.

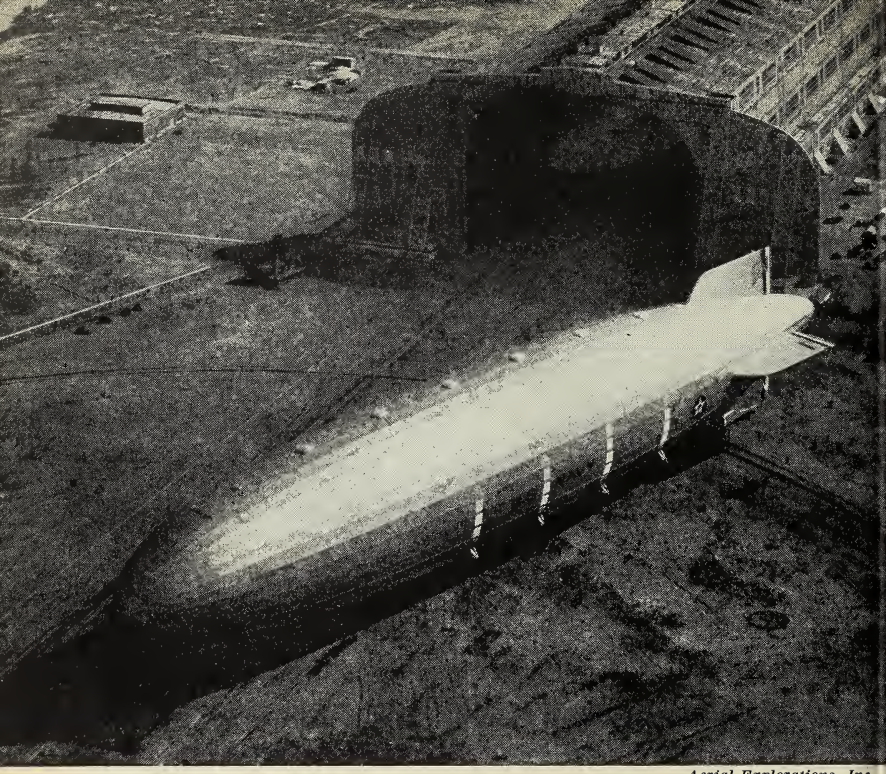


Fairchild Aerial Surveys, Inc.

THE *GRAF ZEPPELIN*

The *Hindenburg* met a tragic fate in 1937, when t attempted to land at the flying field at Lakehurst. The great ship caught fire and was completely burned. The *Hindenburg's* gas chambers were filled with hydrogen. Perhaps the result of this magnificent ship's destruction will be the decision never again to use hydrogen in airships.

Other countries besides Germany made important contributions to the history of lighter-than-air craft. The British dirigible *R34* had crossed the Atlantic Ocean to the United States in 1919, being the first airship to make the transatlantic flight. It was wrecked in England within two years. Both Italy and France had experimented with dirigibles. The Italian *Roma* crossed the Atlantic in 1922 and exploded in Virginia. The French *Dixmude* was lost over the Mediterranean in 1923. In our own country



Aerial Explorations, Inc.

THE *AKRON* BESIDE ITS HANGAR

three great dirigibles have come to disaster — the *Shenandoah* (1925), the *Akron* (1933), and the *Macon* (1935). Out of all these disasters have probably come some knowledge and experience which will help men of the future to solve the remaining problems of lighter-than-air craft.

The problem of a suitable gas, the problem of the right materials for the ship, and the problem of the right construction have all been solved, in a way. Yet there remain the problems of the scarcity and expense of helium, the enormous expense of building a

huge dirigible, and the amount of time that its making takes. Until the dirigible is safe for travel, there can be no regular transportation lines for airship travel. Yet travel by airship may be achieved in a few years.

Reading about Aircraft. These books will give you interesting material on airplanes and airways:

Wonder Flights of Long Ago by Mary Elizabeth Barry and Paul Robert Hanna

The Story of Transportation by Jeanette Eaton

The Story of Aircraft by Chelsea Fraser

Historic Airships by Rupert Sargent Holland

An Alphabet of Aviation by Paul Jones

"We" by Charles A. Lindbergh

Airships. I. Find pictures of early and modern airships. Mount these pictures for your notebook.

II. Prepare a report on one of the following names:

1. Count Ferdinand von Zeppelin
2. Alberto Santos-Dumont
3. Jacques and Joseph Montgolfier
4. Francesco de Lana

III. Explain why the steam engine was not used in airships, and why the gas engine made possible the airship.

IV. List some famous airships. Include the *Dixmude, Macon, Akron, Shenandoah, Los Angeles,* and any others you may know. Who owned, or owns, these airships? Where were they made? What has become of them?

V. Explain each term: *lighter-than-air craft, dirigible, airship, Zeppelin, hydrogen, helium, bag, gondola.*

HEAVIER-THAN-AIR CRAFT

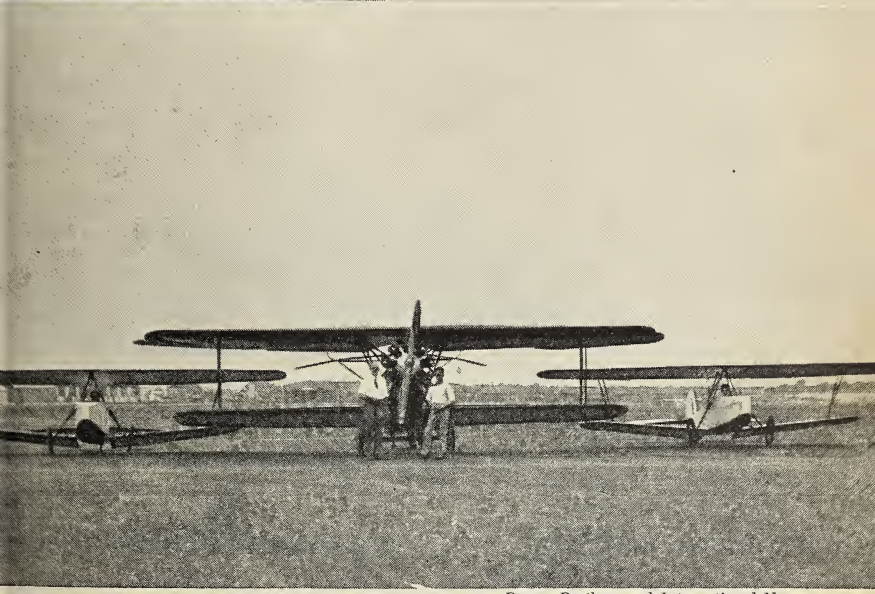
An airship floats in a sea of air for the same reason that a ship floats in a sea of water. The bag of an airship is lighter than the air around it.

An airplane is heavier than air. It has no gas bag. It must be kept aloft by some other means than by floating. How does an airplane stay up in the air?

The airplane is driven by mechanical power. A gasoline engine whirls a propeller. The propeller screws its way through the air. The pressure of the air against the fast-moving wings holds the plane up. The plane can be made to go higher or lower. It can be made to go in any direction the pilot wishes.

It was not easy for men to learn the secret of airplane flying. For hundreds of years they dreamed of making machines that would fly through the air, although they were heavier than air. It was in studying the flying motions of birds that they noticed that birds could soar through the air for long periods of time. They built wings, attached them to their bodies, and attempted to soar through the air. It was in this way that men discovered the glider.

A glider cannot stay above earth very long at a time. It has no engine to control it. It soars, as a bird soars, on the natural currents of the air. The man who rides in a glider balances it with his body. Otto Lilienthal in Germany, Percy Pitcher in England, and Octave Chanute in America all made excellent gliders.



Brown Brothers and International News

GLIDERS

The picture at the upper left shows the Lilienthal glider in flight in 1896.

The Wright glider is shown at the upper right. It made a number of flights in 1902.

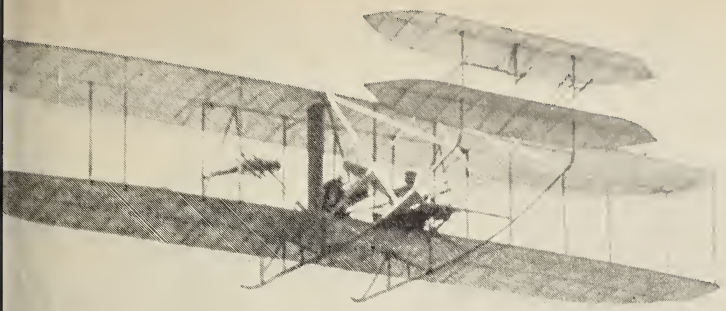
The bottom picture shows a powered plane of today with two modern gliders. The plane flying with the gliders in tow has been called an "aerial train."

Orville and Wilbur Wright, two brothers in Dayton, Ohio, had been interested in flying since they were children. As they grew older, they read of Lilienthal's gliders. This started them thinking about how to build a glider of their own. They designed and built a glider, but the winds in Ohio were not constant enough to suit them. One of the brothers wrote to the United States Weather Bureau for information. He received the reply that Kitty Hawk, North Carolina, had fine, steady winds practically all the year around. So the Wright brothers went to Kitty Hawk with their glider. It was from these early experiments in gliding that they became convinced they could make a successful airplane.

The Wright brothers left Kitty Hawk and returned to Dayton to build their airplane. They had little to start with. They had to design and whittle out their own propeller. They had to build their own gasoline engine. They had to make their own airplane to put it in. Then they returned with their airplane to Kitty Hawk, North Carolina.

On a cold, windy day in 1903 the Wright brothers tried out their airplane. To the surprise of those watching, it left the ground and flew for almost a quarter of a mile. This was a great event. For the first time an airplane flew through the air under its own power guided by a pilot.

The two Wrights went on improving their plane. Others experimented with the airplane, too. The airplane became better and better. In 1914, when



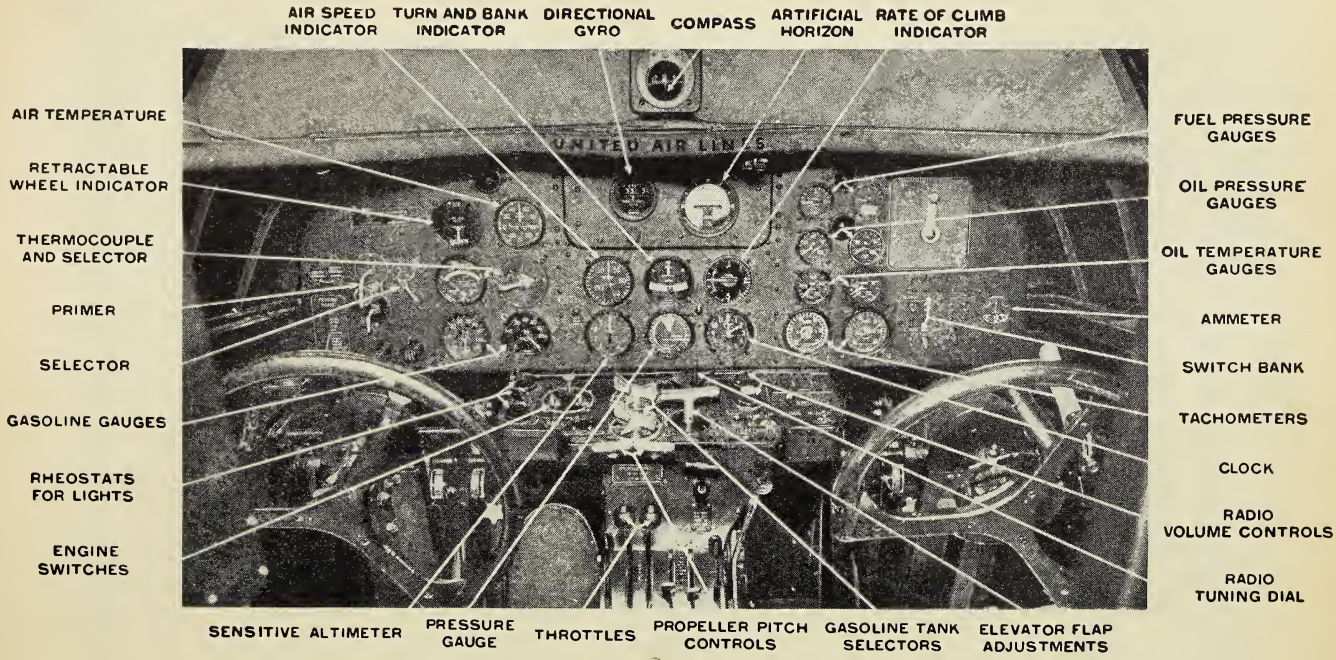
Brown Brothers

THE FIRST SUCCESSFUL WRIGHT AIRPLANE

The early airplane had no cockpit. The pilot sat upon the lower plane. Instead of landing wheels, the plane had runners.

the World War broke out, people began in earnest to make airplanes, for they needed them in the battlefields. Factories made them in great quantities, for by this time airplane making was well-enough developed so that the factories could make standard parts and turn them out by the hundreds. By the end of the war some good airplanes had been built, and men took up the work of making them safer, of providing them with more conveniences, of giving them more speed.

The first airplanes were considered unsafe. This was partly because people did not know the best ways of taking them off the ground, of handling them in the air, and of landing them. They had to learn all of these things by using airplanes. Today young men and women who wish to fly go to a training school where they are taught by experienced aviators.



THE INSTRUMENT BOARD OF A MODERN AIRPLANE

In order to fly safely, men have had to learn a great deal about the weather and about the condition of the air. The air high above the earth is very different from the air directly above it. Sometimes the air contains pockets, or air holes, which make the machine bump up and down. Sometimes storms cover the plane with sleet, or falling snow makes it impossible for the pilot to see ahead of him. How have men tried to overcome these dangers?

The instrument board of a modern airplane is a wonderful collection of safety devices — the sensitive altimeter gives the height to which the airplane has risen; the compass tells the direction in which the plane is flying; the air-speed indicator tells the pilot how fast he is going. Other instruments tell the condition of the atmosphere or of the engine and the amount of fuel on hand. Study the picture on page 222. See how many different instruments there are. See whether you can find out the uses of several instruments of which you have not heard before.

When the weather is very bad, many pilots now fix their eyes upon their instrument boards and "fly blind." Or they can fasten on their earphones and receive reports of the weather or directions for landing from the radio station on the ground. When everything else fails, there is the parachute, which probably will be required of all transport planes in the near future. The parachute is the life preserver of the airplane.

Credit note: The picture on page 222 was furnished by Philip D. Gendreau.

The Story of Airplanes. I. Read all you can about the airplane. (See the book list on page 217.) Then explain the following terms: *ceiling, cockpit, control stick, flying blind, nose dive, elevation, heavier-than-air craft.*

II. Explain carefully the differences between the way that lighter-than-air craft and the way that heavier-than-air craft are kept up in the air.

III. Find pictures of famous airplanes. When can we say an airplane has become famous?

IV. Probably no hero of aviation is as much admired as Charles A. Lindbergh. Make a bibliography of stories about Lindbergh. Read some of the stories. Your class might have a Lindbergh Day, when you tell one another the interesting things you have learned about him.

V. Make a list of famous fliers. After each name on your list tell why the person is famous.

VI. Tell stories of how the balloon and the airplane have aided in explorations of the North and South poles.

THE MEETING PLACE OF THE PLANES

It is hard to realize how many thousands and thousands of people are now traveling by plane. To accommodate these air travelers, airports are built outside many of our large cities.

An airport has runways, just as a railway station has tracks on which trains enter and leave. It has its offices where the pilots make their reports and receive their orders and where the signals are given for both landing and taking off. It has its bulletin boards and weather signals which keep the pilots in

Courtesy United Air Lines

AN AIRPORT AT NIGHT

touch with the weather conditions on their intended routes. It has hangars where the planes are kept, much like the train sheds in big railroad stations. It has gas stations for fueling the planes and shops where skilled mechanics inspect and repair planes. And, like a railroad station, it may have waiting rooms, restaurants, newsstands, information bureaus, telephone booths, baggage rooms, telegraph and radio stations, drugstores, and taxi stands. It has its bulletin boards and its announcers to inform passengers of changes in schedule, the arrival of planes, and the time of their departure.

What does an airport look like? In the center is the landing field. To one side are the hangars. Near by is the administration building, in which are

the offices of those in charge of the airport. Close by is the terminal building, in which are the accommodations for the passengers.

Probably the most interesting part of an airport is the landing field. Sometimes there are four runways. Sometimes there are six or eight. These runways are made of concrete or cinders. They are very smooth and must be at least one hundred feet wide and two thousand feet long. The circle where these runways meet is like the bull's-eye of a target — it is the spot at which the flier aims when he is ready to land. As he comes close to the field, however, he chooses the runway which will lead him directly against the wind, for airplanes in landing and taking off should fly into the wind.

The landing field is well fitted out with lights. The most important light of all is the beacon light, which is placed on a high tower or on the top of a building. The beacon light is really the lighthouse of the airport. Usually it is a revolving light which flashes signals first in one direction and then another. The flashes are made regularly and in code, spelling the name of the field. The beacon light can be seen many miles. It guides the pilot to the field. When a storm or heavy fog hides the beacon light, the pilot is guided into the airport by the use of his radio set.

Surrounding the beacon light are floodlights. They make the landing field as bright as day. They are so arranged that they throw the beams down toward the ground. Some of the floodlights are for

Lionel Green

LOADING MAIL INTO A MAIL TRANSPORT

lighting the hangar and other buildings at the edge of the landing field. Others are for lighting the runways. The floodlights are turned on when a plane is about to land or take off.

The edges of the landing field are outlined with border lights. These are placed on low posts which are painted yellow or yellow with black stripes.

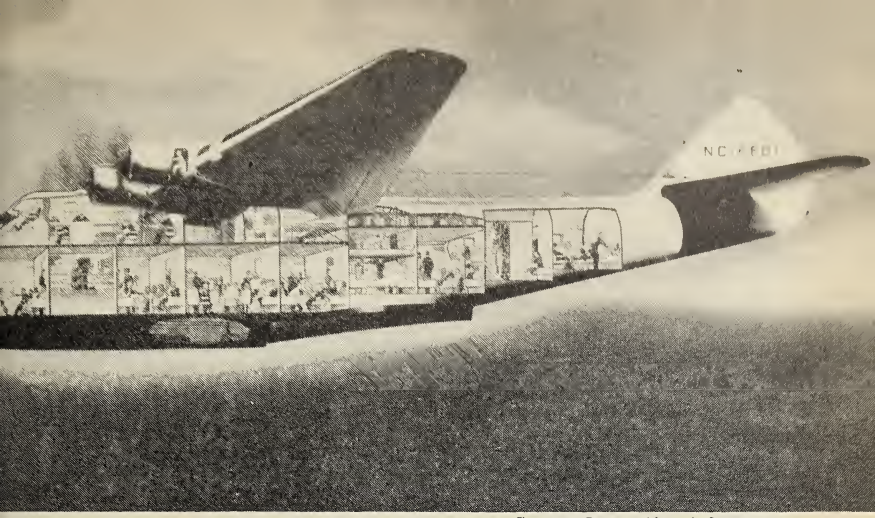
At the ends of each runway are colored lights. Each runway is distinguished from the others by the color of its end lights.

One of the most important lights is on the wind vane. This light shows the pilot the direction from which the wind is blowing and signals the number of miles the wind is blowing per hour. Sometimes the wind vane is a big yellow and black arrow which swings on top of a high pole. Sometimes it is a

wind cone or sock. The wind sock is a long, narrow, pointed bag held open at the larger end by a ring. When the wind blows, the sock is filled with air and the pointed end points to the direction toward which the wind is blowing.

Perhaps no other kind of transportation depends so much upon weather as does flying. Before a pilot starts on his run, he goes to a bulletin board and studies the big map on which his route is shown. The map shows the location of foggy areas and how close the fog is to the ground. It shows the location of storm areas and the kind of storms that are expected — thunderstorms, rain, or snow. In some airports tiny electric lights — white, red, or green — mark the weather conditions for the pilot. White means good weather; green, not so good; and red, storms or fog or heavy winds. Two lights of different colors show that a change is expected. Little bells ring to attract the pilot's attention to changes as they are marked on this bulletin.

As pilots fly back and forth between stations, they are in constant touch by radio with ground stations all along the way. Through the radio they are informed of changes in the weather, fog, visibility, and conditions for landing. By radio they also receive their directions from headquarters. When the weather is foggy or when there are heavy snows, it is sometimes impossible for the pilot to see the signal given by the beacon lights. Then it is that the radio is of especially great value.



Courtesy Boeing Aircraft Company

CROSS SECTION OF A MODERN TRANSPORT

Courtesy United Air Lines

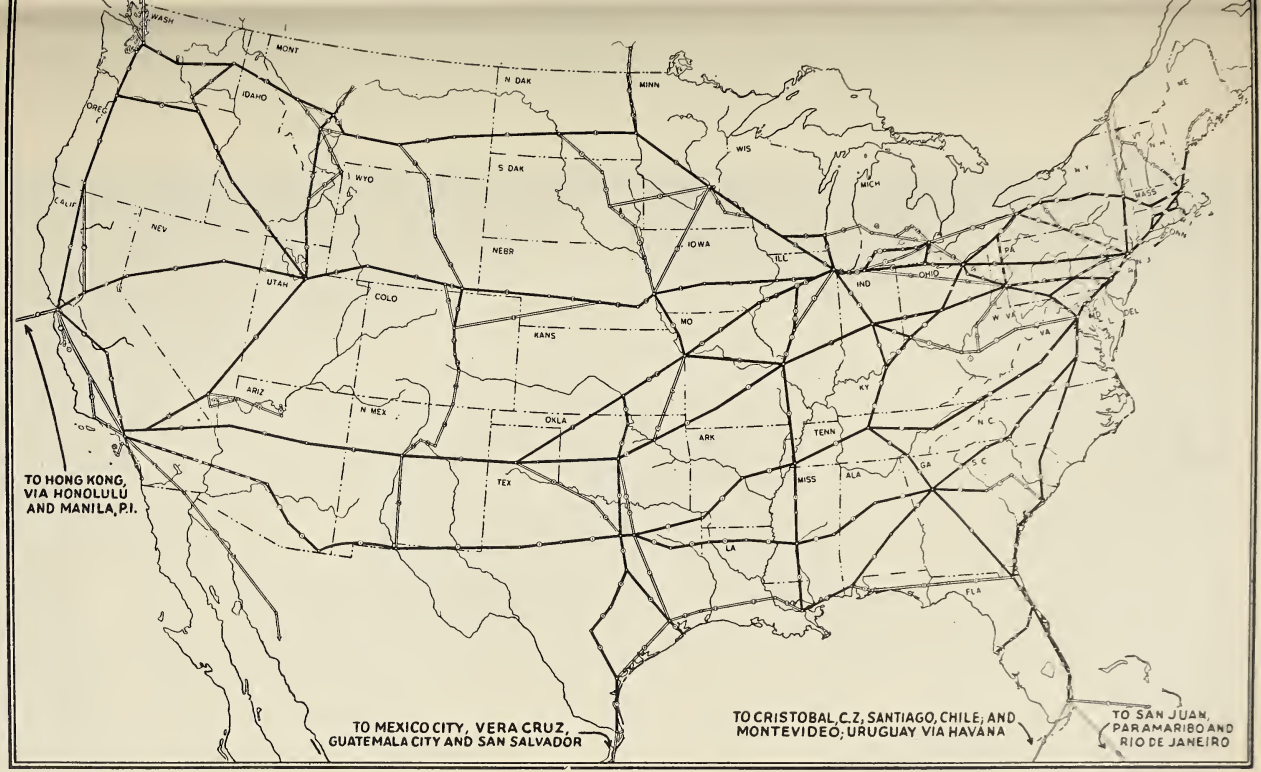
THE LOUNGE OF A MODERN AIR LINER

AIR TRAVEL TODAY

The improvement of the airplane has been rapid. In less than thirty-five years men have solved many of the problems of flying and many of the problems of flying with reasonable safety and great comfort. Air routes cross not only our own land but the other continents of the world as well. Millions of people travel by air each year — businessmen who need to save days and even hours of time; friends, relatives, and medical aid speeding to the sick; speakers, singers, and other entertainers who must make their schedules. Even tourists are taking up air travel.

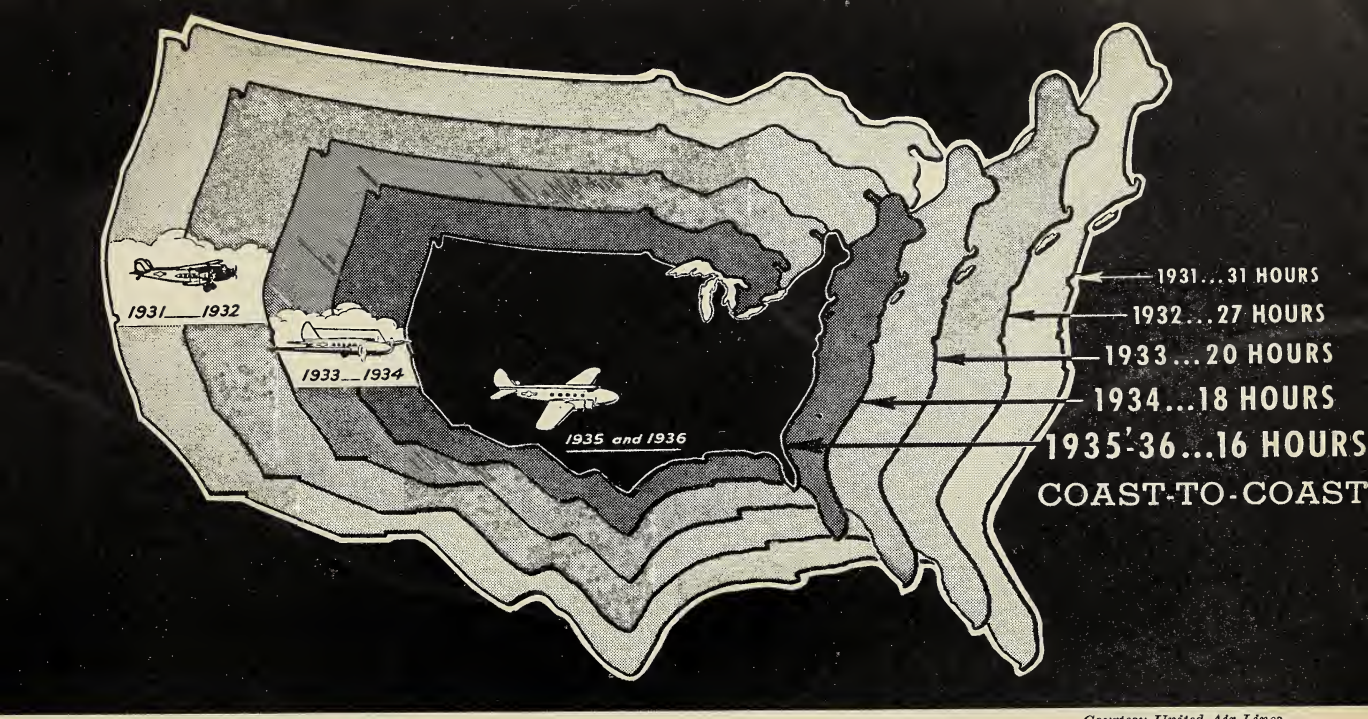
Most of the modern planes are large, some of them carrying as many as forty people. They are luxurious and comfortable, furnishing sleeping quarters, meals, and other conveniences. So, many travelers who dislike to spend days and days on trains or boats are choosing to travel by air, as air travel shortens the number of travel days.

One of the most important uses of the airplane is to carry mail. Airmail routes now reach all of the important cities in our country. Millions of pieces of mail travel by air yearly, including both letters and parcel post packages. You may buy an airmail stamp at the post office. You may buy special airmail envelopes. You may find a special postbox for airmail in most large post offices and in many hotels. Airmail is sent out daily from many business offices.



U. S. Department of Commerce

MAP OF AIRWAYS



Courtesy United Air Lines

HOW AIR TRANSPORTATION HAS CONQUERED SPACE

If you measure the distance from our west coast to our east coast in hours of travel, you can see why the map above shows the United States as shrinking. Study the map to get its story. Find out whether more shrinkage has occurred since the time when this map was made.

Often letters are sent from private homes by airmail. It takes mail four or more days to travel by train from New York to Los Angeles. A mailplane can make the same trip in eighteen hours. A letter sent from coast to coast by airmail will outstrip a letter sent by train by about three and one-half days. Airmail service greatly increases our speed in written communication.

Using the Airways. I. Explain why the study of weather conditions has become such an important feature of airports.

II. What part does the United States government play in making air transportation safe?

III. Turn to the airways map on page 231. What states would a letter pass over going from Seattle, Washington, to Chicago, Illinois? From New York to San Francisco, California?

IV. Name three kinds of messages which a person might choose to send by airmail. Name three kinds of trips a person might wish to take in an airplane.

V. The radio beam, used in aviation, is a means of communication, because it directs the pilot from the ground. What two other means of communication between fliers and the ground are mentioned in this story?

VI. Watch the newspapers for an account of a flight of the *China Clipper*. What route does it follow? Trace the route on a map. How many tons of mail does the clipper carry? How many passengers?

VI. INSTANT COMMUNICATION

As long as messages could travel no faster than the men or the vehicles that carried them, the story of transportation and the story of communication were largely one story. Less than one hundred years ago communication became free from the tie that bound it to methods of travel. For the first time communication was able to develop its own methods. How did this happen? What set communication apart?

THE ELECTRIC TELEGRAPH

There are not many things to tell of early communication methods which have not already been told in the story of transportation. For thousands of years, every victory in man's efforts to overcome distance was a victory for communication.

Yet it is true that early man did develop some methods of communication which had nothing to do with transportation. He learned to use signals — *sight signals* and *sound signals.*

The African forest people of today send messages to one another through the beat of the tom-tom. They have a code of tom-tom beats. A message can be sent great distances by the tom-tom, for the sound carries for miles. The code beats are usually taken

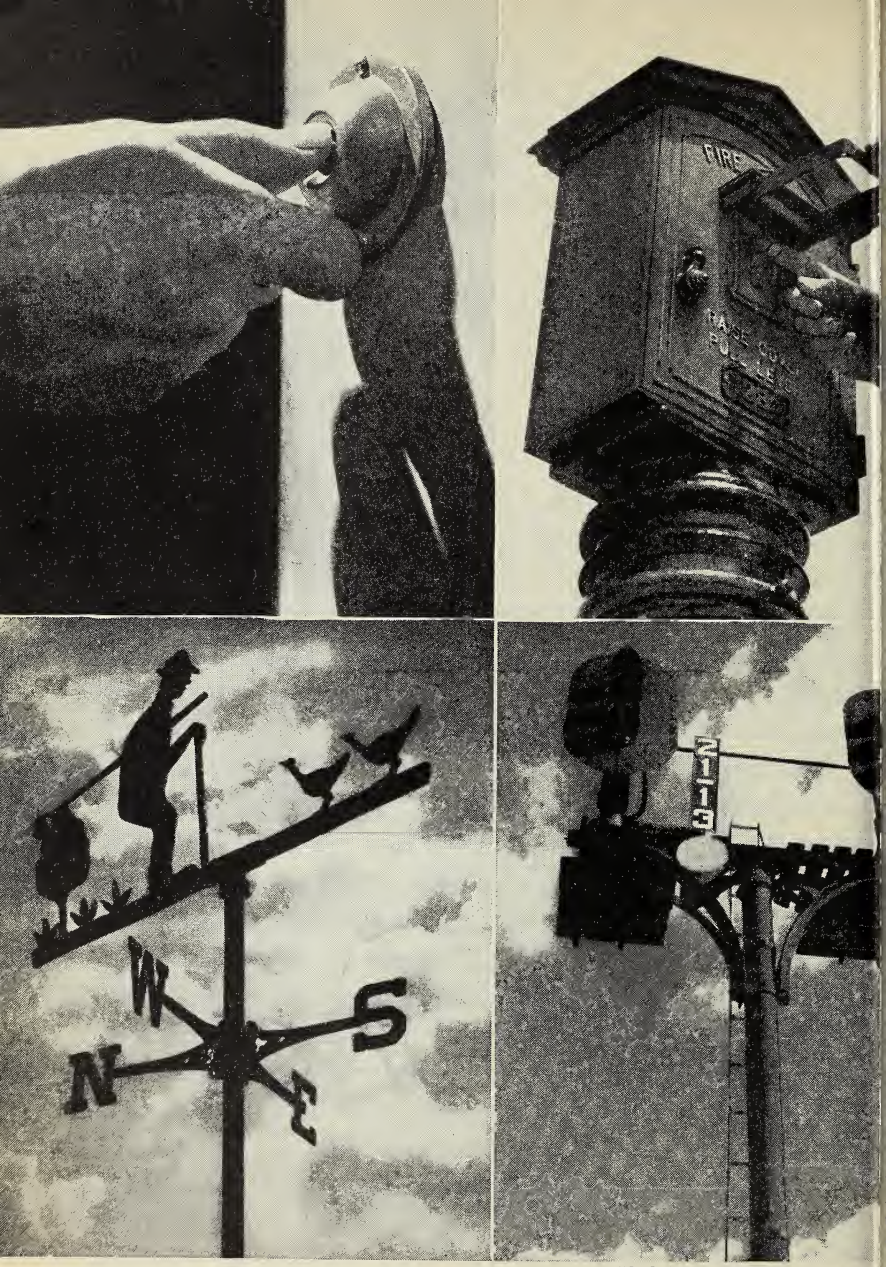
up and repeated by a series of drummers stationed along the way, or they are relayed from village to village.

We use sound codes ourselves. The firing of cannon carries a message. The ringing of a bell conveys a meaning to us. Sound signals are a simple method of telegraphing.

Sight signals have been developed by earlier peoples, too. You are familiar with the smoke signals of the American Indians. Torches and lights have been used as sight signals by primitive people and are even used by us today. The railway semaphore is a sight signal. The traffic signal which you obey on the street is a sight signal. Flags and pennants on ships carry messages to the eyes of those who can read them.

Communicating over long distances developed slowly up to a hundred years ago. The human runner, the horse-drawn vehicle, the railway, and the steamboat were steppingstones in the improvement of communication. Then, almost overnight, a giant step was taken. Man learned to use electrical currents for the sending of messages.

The story of electrical communication begins in England. Sir Charles Wheatstone and William Cooke were the inventors of the electric telegraph. By 1837 Wheatstone and Cooke had perfected an instrument for sending and receiving messages. This instrument was used in England for a number of years.



Black Star and Philip D. Gendreau

SIGNALS OF THE PRESENT DAY

Tell which are sight signals and which sound signals.

The telegraph instrument first used in the United States was invented by Samuel Finley Breese Morse, a young American painter. In 1832, as he was returning to the United States from Europe, he happened to sail on the same ship with Dr. Charles T. Jackson. Dr. Jackson was interested in some new discoveries in electricity, and a discussion took place in which he described an electromagnet to Mr. Morse. Although Morse was an artist, he had always been interested in electricity. While he listened to Dr. Jackson, an idea for sending messages by electricity came to him. When he returned home, he set about to work out his new idea.

His first instrument was very crude. His first code was so complicated it would have taken a huge dictionary to explain it. But Morse believed in his idea, and he sometimes went without food in order to save money for his telegraph.

After four years of work Morse called upon Professor Leonard D. Gale. Professor Gale became interested in the invention and gave Morse some helpful information about electricity. The next year Alfred Vail also became interested in Morse's invention. Mr. Vail assisted Morse with both money and new ideas. With the help of these two men Morse was able to make an electric telegraph.

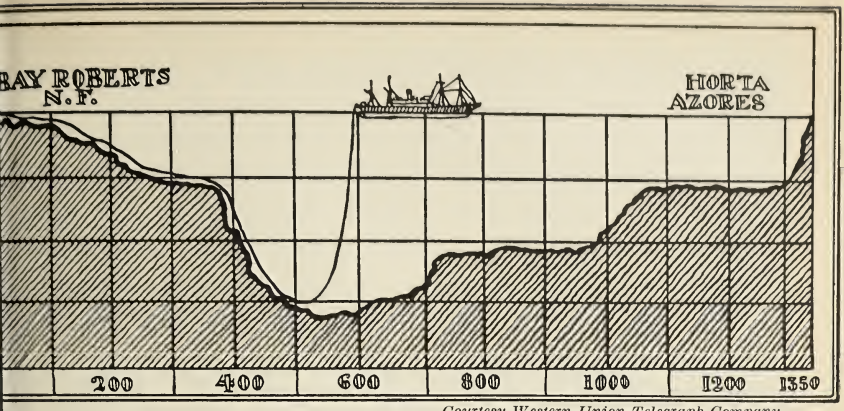
What was the great problem before Morse and his helpers? What were they trying to do?

Sending messages by means of an electric telegraph requires five things. First, there must be a supply of

electric current. Second, there must be a path over which the current can pass. Third, there must be a sending instrument. Fourth, there must be a code by which a message can be interpreted. And, fifth, there must be a receiving instrument.

Morse did not have to worry about the first two problems. Men already knew how to generate electric current and send it over a wire. His first problem consisted in making a sending instrument. He worked out such an instrument by making a key with which he could open or close the circuit of electric current. Next he worked out a code of dots and dashes. A dot was a quick tap of the key. A dash was a longer pressure on the key. By arranging dots and dashes in different combinations, he was able to represent each letter of the alphabet. The receiving instrument was Morse's most difficult work, but he succeeded in making one. When the key at the sending end of the wire was struck, the current ceased to flow, and a lever at the receiving end of the wire fell with a click. The falling lever clicked out the message in code.

In 1838 the telegraph was completed. It was tested and found to be able to do all that was claimed for it. Morse then undertook to get Congress to grant some money with which to build a telegraph line between Washington and Baltimore. It took some time, but in 1843 Congress voted to spend $30,000 for the project. For over a year Morse and his partners worked on the new line. On May 24,



Courtesy Western Union Telegraph Company

LAYING AN ATLANTIC CABLE

This cross section shows the depths of the floor of the ocean at different points.

1844, Morse sent the following message from Washington to Vail in Baltimore: "What hath God wrought?" In a few minutes Vail sent back the same message to Morse.

Morse offered to sell his invention to the government for $100,000. The government was not interested. Congress voted him $8000, however, to be used in keeping up the line between Washington and Baltimore. Strange to say, the people of America did not at first take any particular interest in this new electrical system of sending messages.

Other inventors began to work on Morse's idea. Thomas Edison discovered a way of sending four messages on a wire. Little by little, the electric telegraph, as we know it today, developed.

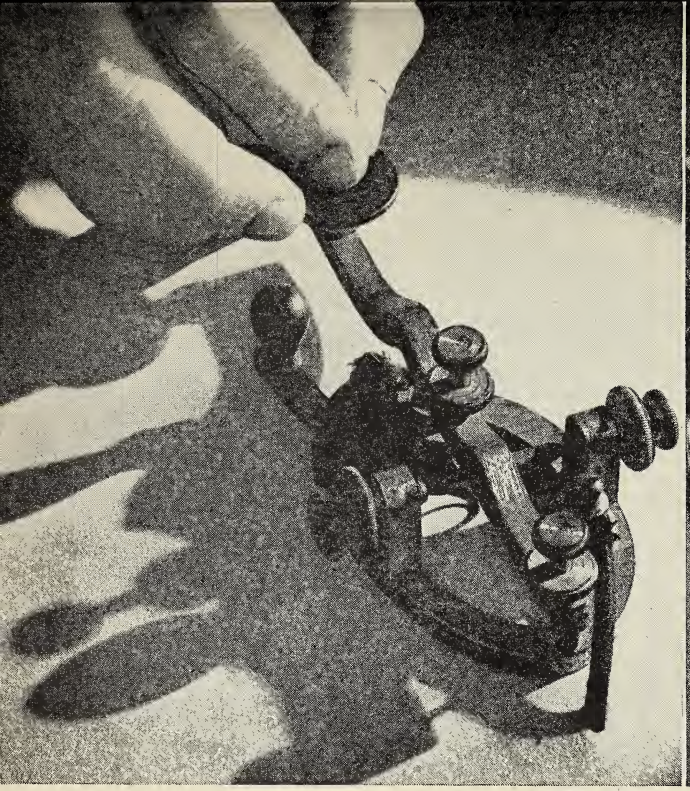
In 1855 Cyrus W. Field began to lay a cable across the Atlantic Ocean to be used in telegraphing messages to Europe. This cable broke in mid-ocean.

He tried again, and again the cable broke. It was not strong enough to stand the pressure of the water, the sharp rocks, and the pull of its own weight. Finally, in 1866, Field was successful. Twenty-five hundred miles of cable lay at the bottom of the ocean. Through this cable, messages could be sent to the people on the other side of the world.

By 1861 telegraph wires were strung across our own country from coast to coast. Ten years later, telegrams and cables carried most of the important messages of the business world. Electric communication had become established.

How do we use the electric telegraph today? In many ways. Personal problems are settled over the telegraph wires. Business is transacted. Money is exchanged. The railroad system of America has until lately depended upon the telegraph for sending and receiving the messages that kept the trains on schedule. The news of the whole world is flashed by telegraph and cable lines. The *teletype* — a machine that is a combination of typewriter and telegraph instrument — transmits news to hundreds of newspaper offices at the same time.

The invention of the electric telegraph marked an important step in human progress. No longer was communication tied to vehicles of transportation. It now had its own vehicle — electric current. With one mighty step communication had leaped ahead of transportation, for electric communication brought instant communication.



Ewing Galloway

OLD-TYPE TELEGRAPH KEY

Philip D. Gendreau

TELETYPE INSTRUMENT AND OPERATOR

THE ELECTRIC TELEPHONE

During the time that men were trying to improve the invention of Samuel F. B. Morse, they were also trying to find a way of sending the human voice over wires. They worked on this problem until 1876, when it was solved by Alexander Graham Bell.

Mr. Bell was a teacher of speech. He taught deaf people to use their vocal cords. It was through his study of ways to help deaf people hear and speak that his ideas for the telephone came to him. Bell worked for months trying to make an instrument which would transmit the sound of the human voice in words that could be understood. He made models, using electromagnets, clock springs, batteries, and wires. And then one day he was rewarded for all of his work.

Bell was working with a model of what he called a *harmonic telegraph*. In handling the model, Bell's assistant, Thomas A. Watson, touched a wire in which electricity was flowing. A sound was produced. By studying what had happened, Bell found the secret of making a telephone. He was encouraged to continue experimenting. He worked for forty weeks trying to build a telephone. Then one day Watson, who was working in a different part of the house from Bell, heard Bell's voice over the instrument. "Mr. Watson, please come here. I want you," the voice said. Watson went. He burst into Bell's room almost too excited to speak.

Inventing a telephone was difficult enough. But getting people to use it and like it was difficult, too. People could see no use for such an invention. Bell gave lectures explaining the use of the telephone. He exhibited his telephone and invited people to use it.

Twenty years after Bell's invention, only 339,500 telephones were in use in the United States. But by 1937 this number had increased to 19,000,000 telephones. Today almost every town and village in the United States has its telephone system. Over 350,000 workers help us carry on our telephone conversations.

The telephone is part of our everyday living. Probably most of us think we could not do without it. Certainly we should have to change our ways of living were we forced to do without the services of the telephone. Families have learned to telephone for supplies in place of running errands. Much business is carried on over the telephone. The telephone adds to our social enjoyment, for it has made neighbors of people living far apart. The telephone is also a means of protection. People use it to call the doctor, to warn others of danger, to call for help in times of emergency. Alexander Bell carried instant communication one step farther than the telegraph. He has given us a means of communication which almost equals direct speech. He has made it possible for the human voice to be heard across a continent.

MESSAGES THROUGH THE AIR

Through the invention of the telegraph and the telephone, men are able to send code messages and even the human voice over wires. Today, signals, the human voice, music, and other sounds may be sent through the air without the aid of wires. What is this *wireless* method of communication? How did men discover it?

There are two kinds of wireless communication. One is *wireless telegraphy* by which a message is sent by code. Ships send messages to shore, airplanes send messages to ground stations, and people exchange messages with people in foreign countries over wireless telegraphs.

Wireless telephony is the second kind of wireless message sending. As we hear the human voice over an ordinary telephone, we may hear the human voice by wireless telephony. A call by telephone, if made across the sea, employs wireless telephony. Our radio, too, is a kind of wireless telephony.

Before men could discover any form of wireless communication, they had to learn certain things about the air and some of the secrets of electricity. Almost one hundred years ago, an Englishman, James Clerk-Maxwell, claimed he had proved that he could put air waves into motion by means of electricity. But what were air waves? No one had ever seen them, for they are invisible. No one had ever heard them or felt them. Probably, many people did not believe in air waves. But not long after

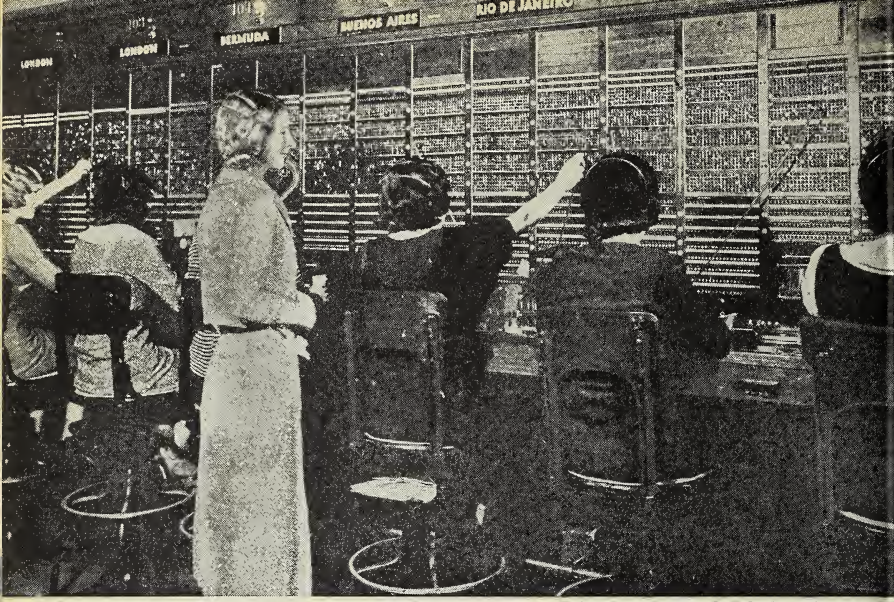
Courtesy Radio Corporation of America

R.C.A. RADIO STATION AT ROCKY POINT, LONG ISLAND

This important radio station has communication with thirty transatlantic countries.

Clerk-Maxwell's brilliant discovery, Heinrich Hertz, a German, actually produced air waves by electricity and invented a means of detecting these air waves.

Air waves are something like water waves. When you drop a pebble in water, you see circular waves start out on the surface of the water. The stone is the disturbance which causes the water waves. Electricity is a disturbance which causes air waves.

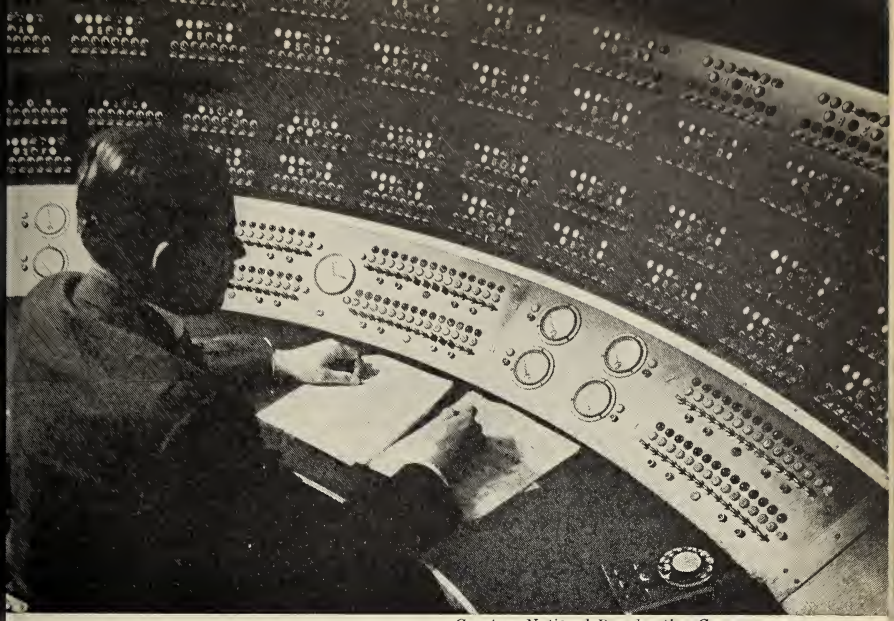


Courtesy New York Telephone Company

A TRANSOCEANIC SWITCHBOARD

The names printed above sections of the board indicate the reach of the wireless telephone.

But men did not immediately discover how to make these waves do the important work of communication which they do today. They were not useful until Guglielmo Marconi, a young Italian boy, showed people how to send sound by wireless. Marconi was twenty-one years old when he began to experiment with telegraphy. He placed a sending apparatus on one side of his father's back yard. On the other side of the yard he placed a receiver. He attempted to send wireless signals between these two instruments. At first, the sounds were weak and blurred and could travel only a short distance. But by improving his instruments, he strengthened



Courtesy National Broadcasting Company

CONTROL DESK OF A GREAT RADIO COMPANY

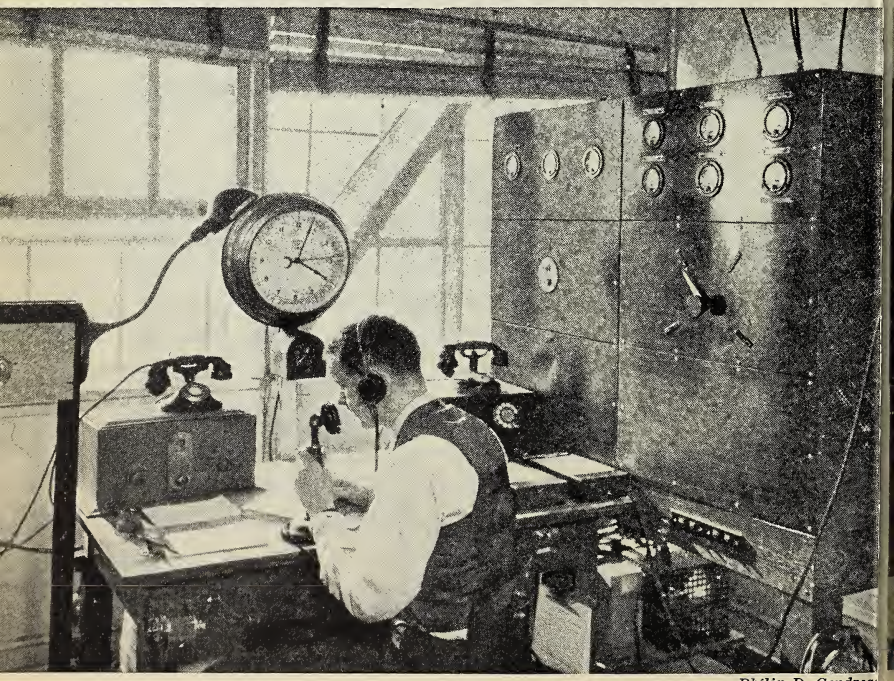
The lights represent different stations which may be connected for a nation-wide broadcast.

his signals. In six years' time he was demonstrating wireless telegraphy. He sent messages from stations on board ships to stations on the shore. He even sent messages across the English Channel.

In December, 1906, sound first traveled across the ocean by means of air waves. The sound was the letter *S*. It came from Cornwall, England, straight to Newfoundland, on the coast of America. Marconi was flying a kite high to catch the sound as it traveled through the air. From the kite the sound was led into a wireless receiving set. This wireless message of a single sound was one of the most important events in the history of communication.

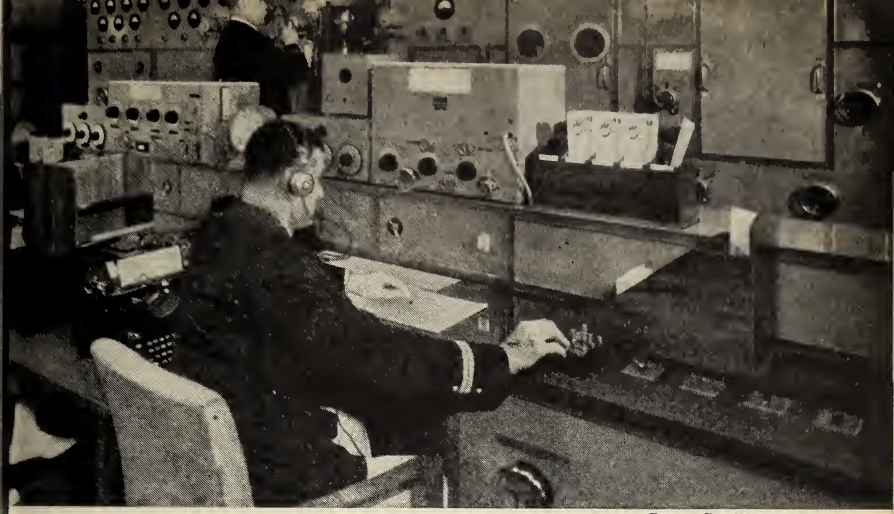
Philip D. Gendreau

TALKING TO THE GROUND STATION BY RADIOTELEPHONE



Philip D. Gendreau

THE GROUND STATION TALKING TO THE PLANE CREW



Brown Brothers

CONTROL ROOM OF A GREAT OCEAN LINER

Today radio occupies an important place in the life of our country. Wireless messages from ships in distress, from airplanes in storms, and from people exploring unknown places often save lives. But it is the everyday use of the radio which changes lives.

By radio, food experts advise housewives on how to feed their families. By radio, the President of the country explains the problems of the nation. Radio permits people to listen at home to good plays and good music and to interesting lectures on travel and other topics.

Communication by radio brings people of one large nation closer together in their thoughts and feelings. It teaches people more about people in faraway lands. Communication is no longer just a way to send an urgent message. It has become a means of education for everybody.

Reading about Communication. Look in the Table of Contents or the Index of each book listed on pages 133–134 and 192 for interesting material on communication.

The Magic of Instant Communication. I. If someone in the class has a toy telegraph set, ask him to bring it to class and explain how a message is sent by telegraph.

II. Find out how the telephone operates. Explain it to the class by means of diagrams.

III. Ask someone to bring a radio set to class and explain its operation.

True Adventure Stories. Select one of the following topics. Find out all you can about it from an encyclopedia or from a science book and report to your class.

1. Samuel F. B. Morse and the telegraph.
2. Laying the Atlantic cable.
3. How Marconi discovered wireless.
4. Speaking around the world by telephone.

Our Big Neighborhood. I. When Commander Byrd was in Little America at the South Pole, the people of our country heard him talk by radio a number of times. Explain why this was a wonderful event. Compare it with the time of Columbus's discovery of America.

II. Classify under the following headings the radio programs which your family enjoys: (1) Sports, (2) Current News, (3) Art (literature, music, or drama), (4) Public Affairs (political speeches, public questions), (5) Practical Information. Tell how these programs benefit you.

III. What do you think people mean by saying that the telephone, the telegraph, and the radio have made the world "one big neighborhood"?

VII. WHAT ABOUT THE FUTURE?

What new vehicles will speed over land, over water, and through the air in the future? Will we discover new ways to communicate? Will we learn to use all our means of transportation and communication as a means for providing greater comfort and pleasure for all the people in our country?

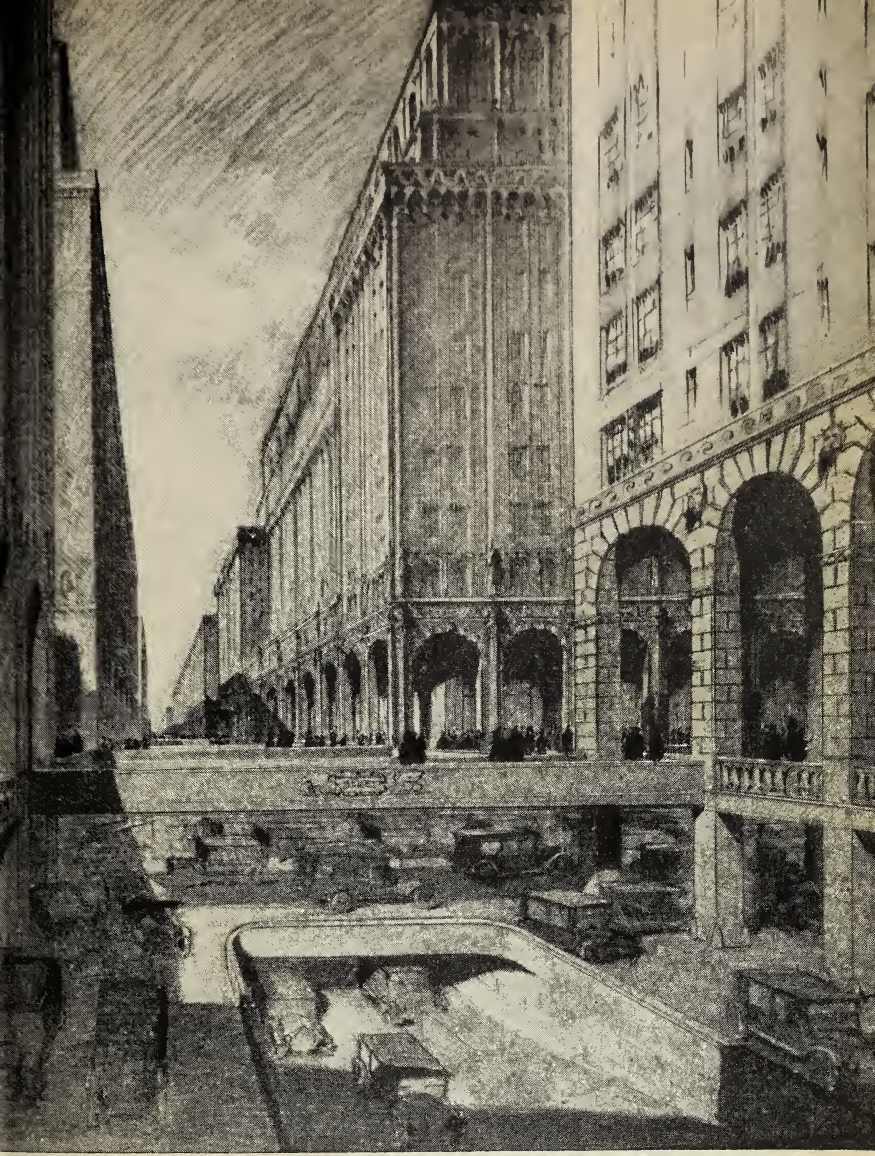
PROBLEMS OF THE AUTOMOBILE

Can the automobile be improved? The first problem for the future of the automobile is the problem of *cost.* In laboratories of great automobile plants men are at work trying to improve the automobile engine so that it will use every bit of power that the gasoline can produce. Our engines today waste gasoline power. Today we think well of an automobile that can run twenty miles on a gallon of gasoline. In the future we hope to be able to make fifty miles on a gallon of fuel. Our experimenters are also trying to perfect the Diesel engine for use in the automobile. The Diesel engine uses crude oil instead of gasoline. Since crude oil is cheaper than gasoline, the Diesel engine will make it possible to operate an automobile more cheaply. Since it is the cost of fuel that makes an automobile

too expensive for many families, we expect that the engine of the future will make it possible for more people to own automobiles. Such an engine will bring more convenience and more pleasure to the lives of people.

The problem of *comfort* seems to have been solved. Cushioned seats, rubber tires, well-built automobile bodies, improved springs — all these have produced comfortable riding in the automobile. Yet each year sees new improvements which add to comfort: adjustable windows, sunshades, adjustable seats, armrests, electric lighting, and many other conveniences. There are so many improvements of this kind that the buyer of a car needs to be sure that he is paying for solid worth in a car instead of for some new gadgets which add but little to the real value of the car.

Another problem of the automobile is *durability*. Our materials, our machines, and our laboratories are capable of turning out automobiles that are so strong and so well built that they will last a lifetime. Do we want an automobile to last that long? If we like to change styles in cars as some people change styles in clothing, then perhaps a car less durable is the better thing to have. The problem of durability, then, is the problem of the buyer rather than of the producer. The buyer can decide whether he wants changing styles — whether he wants to buy a durable car that will last many years, or to buy a less durable car and buy more frequently.



Courtesy Regional Plan Association, Inc.

A DREAM OF CITY PLANNERS

In large cities traffic congestion creates serious problems. City planners believe that three levels of highways will be needed in the future.

Producers of automobiles are still working upon the problem of *speed.* Many cars today are capable of traveling at the rate of sixty to seventy-five miles an hour. Racing automobiles have reached a speed of over three hundred miles an hour. Yet the greater the speed, the greater the problem of *safety.* In many states, laws try to regulate the speed of automobiles; yet speed on our highways is still a menace to safety. Now that we have achieved speed in travel, what can we do to insure safety?

Our great problem, therefore, may be the driver. How can we teach him to operate his automobile correctly and to inspect his car regularly to see that all parts are in order? How can we make him feel responsible for the safety not only of himself and his passengers but also of all whom he passes?

We may pass laws, it is true. But the best cure for the evil is for each driver to remember that he is a responsible citizen, bound to respect the rights of all who may choose to use the highway. Can we educate him to understand his responsibility?

A Car for Everyone. I. How many cars would we need, do you think, if every family could own a car?

II. Tell why you think people buy new cars.

III. Look at a new automobile and list the things in it that are not very necessary. Explain why people are likely to think them important.

IV. Find out about the Diesel engine and about how the automobile producers are experimenting with it.

PROBLEMS OF PUBLIC TRANSPORTATION

The railroad is our fastest form of public transportation on land. In recent years, the railroad companies have built new streamline trains with luxurious air-conditioned diners, coaches, and pullmans. It is a pleasure to ride on these fast-going trains. They are swift, they are clean, and they provide every convenience and comfort for the passengers.

But not all our railroad trains are air-conditioned, fast-moving, and smooth. Most of them jolt and jerk over bumpy tracks. They are uncomfortably hot in summer, and they are either stuffy or cold in winter. The tracks for many of our railway lines were laid many years ago in the period when railways were built rapidly. The roadbeds were poorly prepared and have never been improved. Many engines still in use are of the older type, consuming coal to produce steam. They send off black smoke which fills the coaches with soot. They are noisy, too.

Many people are looking forward to the electrification of our railroad lines. Today we have trains run by electric engines near our big cities in the East and on longer runs across some of the western states. Electricity is cheaper for running trains, but it is expensive to install. Therefore, railroad companies hesitate to electrify their lines. For some years railway lines have found it hard to meet their operating expenses, for automobiles and bus lines have taken passengers and freight from the railway lines.

How can we solve the problem of improving all our railway lines? Some people think it can be solved by redistributing the services of our public transportation lines. What do they mean?

They mean that railway lines should perform certain kinds of transportation services, that ships and boats should perform other kinds of transportation services, and bus lines should perform still other kinds. How can this be done?

Perhaps some day railway trains will make only long-distance trips. High-powered engines pulling from one hundred to two hundred heavily loaded cars will speed back and forth between our larger cities. They will run for hundreds of miles without stopping for anything except to change crews and to take on fuel. Where will they get their loads? At the great centers of trade — our large cities — to which the motor trucks and busses will carry the goods and passengers from the surrounding parts of the country. If that time comes, the railroads will not need thousands and thousands of miles of tracks which now serve small towns. They will use fewer locomotives and fewer cars than they need today. They will never carry empty cars, as they sometimes do today. There can then be fine, modern, rapid trains moving on improved roadbeds between our larger cities.

What will these trains carry? They will carry passengers on long trips in the greatest of comfort and at great speed. They will be used to move perishable

Pictures, Inc.

CONTRASTING THE NEW AND THE OLD

freight which must be moved quickly — milk and meat and fruits and vegetables. They will be used to carry articles which have to be heavily insured because of their great value, such as raw silk from China and Japan. Owners of such goods want fast transportation, for transportation insurance costs thousands of dollars for each day of travel.

But these long-distance trains will not have to carry all kinds of freight. There are some things which are not perishable and may be ordered far in advance of the time they are used. The length of time it takes to get coal or iron from one place to another usually makes little difference, but the cost of carrying such articles does make a difference. Heavy articles, such as coal and iron, may be sent by water,

for water transportation is one of the cheapest ways of carrying freight. Engineers tell us that many of our inland waterways can be improved until they are deep enough and wide enough to permit freight boats to travel on them. These improved waterways can carry freight which may travel slowly.

Heavy freight that flows — gas and oil — will probably be transported entirely through pipe lines. Pipe lines can be built much more cheaply than railroad tracks can be built. They can be kept in repair more easily. Even today we have almost as many miles of pipe line as we have of railroad tracks. In the next few years pipe lines will probably become more and more important, for inventors are finding ways of turning coal into fuel gas at the mines. When gas is sent through the pipe lines directly to the furnaces of the homes and factories, it will not be necessary to carry coal from one place to another.

Whether or not we think it would be well to redistribute our transportation services, we all know that our public transportation problems need study. The thing we need is the best kind of service, for all people in all parts of our country, and for the smallest cost. Some people think this problem can be solved only by our government's taking over the transportation lines of our country. They believe that government control would do away with needless competition among different lines. They believe that only the government can have an interest in providing the best service for all people, because the government

is not interested in profits. But many other people do not believe in government ownership of the transportation lines. They believe that the problem can be solved in some other way.

Land Transportation. I. Find out which railway lines in our country are electrified; which use the Diesel engine.

II. Discuss competition. First look the word up in a dictionary. Then cite as many examples of competition as you can think of. Try to think whether competition helps or hinders progress.

III. Sketch a map of our country and on it show how the transportation services might be distributed. Use one color to show railway lines, another to show bus lines. Mark the water routes and show how they might connect with railway or bus lines.

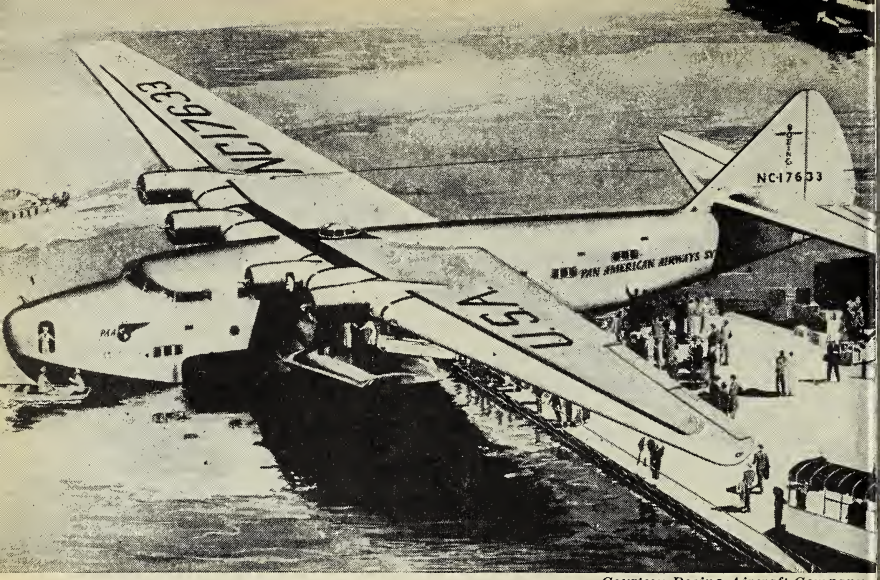
IV. Find out about the use of pipe lines. How big are they? How are they made and how kept in repair?

PROBLEMS OF AIR TRAVEL

Great speed in passenger travel will probably be the work of airplanes in the future. Already the airplane has shown that it is fitted to do this work.

Men who are studying the airplane say that in a few years planes will be speeding through the air at the rate of five hundred miles an hour. Some even say they will move at the rate of a thousand miles an hour. How can these men hope to get such speed?

It is expected that greater speed in airplane travel will come through cutting down the resistance of



Courtesy Boeing Aircraft Company

A TRANSOCEANIC FLYING BOAT

This huge flying boat is planned to carry seventy-two passengers and a crew of eight from one continent to another.

the air through which the plane has to travel. Probably the most important step in getting greater speed will come through changing the airways. In the future aviators will probably take their planes high above the clouds into the region called the substratosphere. In the substratosphere the air is much thinner than it is near the ground. Up there, planes will be able to go much faster, for the air will not push so hard against the planes as they travel. They will not be troubled with storms or fog or the tops of mountains.

But substratosphere flying requires a different type of plane from the one in common use today. One reason is that it is hard for people to breathe

in thin air. It is hard, too, for engines to work in thin air. For some years scientists have been trying to solve the problems of flight in the substratosphere. They have built an airplane having an airtight cabin. In an airtight cabin people will be able to ride in comfort and safety, for they will breathe air just like the air they breathe while on the ground, supplied from tanks of condensed air taken up from the ground. A device called a supercharger will change the condensed air into air of the right quality. This air will also be supplied to the engine that moves the plane.

Men are still working on this problem of the proper plane for stratosphere flying, and they expect success. In fact, experimental flights into the substratosphere have already been made. Possibly before many years all our long-distance sky lanes will lead through the substratosphere.

The Future of Transportation. Watch the daily newspapers for pictures of new vehicles of air transportation. Find out about the arrowbile, the autogiro, and the latest improved glider.

A Closed Cabin. Find out about recent experiments in substratosphere flying with airtight cabins.

Thin Air. Read in a science book about the air blanket that surrounds the earth. Be ready to explain why the air becomes thinner as the distance from the surface of the earth increases. Find out about some recent balloon flights into the stratosphere.

THEN.....AND.....NOW

1920—FIRST TRANSCONTINENTAL AIR MAIL (FLOWN BY DAYLIGHT ONLY)—3 DAYS EASTBOUND; 4 DAYS WESTBOUND

1860—PONY EXPRESS—11 DAYS ST. LOUIS TO SAN FRANCISCO

1830—OX TEAM—SIX MONTHS

1924—FIRST DAY AND NIGHT SERVICE—32 HOURS SAN FRANCISCO TO NEW YORK—34¾ HOURS WESTBOUND

1869—FIRST TRANSCONTINENTAL RAILROAD— 27 DAYS

1856—STAGE—21 DAYS ST. LOUIS TO SAN FRANCISCO

TODAY— COAST-TO-COAST SERVICE —
16 HRS. EASTBOUND—18½ HRS. WESTBOUND

TODAY—BY TRAIN—70½ HOURS

TODAY—BY BUS—92 HOURS

Courtesy United Air Lines

A STORY OF PROGRESS

NEW WAYS TO COMMUNICATE

Today, we have instantaneous communication. We do not need faster ways of sending messages, the human voice, or music through the air. Does this mean that we shall stop looking for new ways to communicate?

No, men are not yet satisfied. Scientists are constantly at work on improving our present means of communication. They are inventing new ones, too. And important discoveries are being made.

The *radiotelephone* is a new communication device, too. It is a very small telephone which slips into the vest or jacket pocket. By means of this device, it will be possible for people, while walking on the street, to speak with distant friends. The radiotelephone has been successfully demonstrated. It is predicted that the time will come when each person will have his radiotelephone number!

In the field of radio much is being done to improve transmission and reception. A few years ago, we listened to squawks and squeals and were delighted if occasionally we heard a strain of music. Today, the voice on the radio is clear; we hear all the notes of music, almost as well as if we were in sight of the orchestra. But men have not yet finished improving radio.

Men have said, "We can send sound to and from the most distant places on the globe. Why can we not also send pictures?"

Francis Jenkins, an American inventor, was certain that it was possible to send pictures through the air. He held a government position in Washington, D. C., but he was so deeply interested in inventing that he gave up his position. He spent all the time he could studying and experimenting. In 1922 Jenkins succeeded in sending a photograph by radio. Two years later, he was able to radio a picture in which an object was moving. How excited he must have been! A new kind of communication was begun. We call sending images by radio *television.*

Television is still in its experimental stage. There are television broadcasting stations in New York City, London, and Berlin, and constant effort is being made to perfect this new method of communication. Some day we shall be able not only to hear a song or a speech over the radio, but also to see the singer or speaker as though he were in the same room with us. Some day we may be spared the trouble of going to a cinema or a theater; we may sit in our own homes, turn on the radio, and see the vision of a play produced by actors upon a far-distant stage.

The radiotelephone and television are not yet ready for general use. Possibly they will never be really practical for common use. But scientists think they will be among the methods of communication in the future. If they are perfected, they will affect our lives. They will change our habits of living. It remains for the future to reveal what revolutionary effect they will have upon the world.

Many people do not believe we are yet ready to handle intelligently our present means of communication. They say our radio programs do not always have the best influence upon us. Will our new means of communication create still more problems? If we are to have television in our homes, will it cause nations to live more peacefully together? Or will we be aroused by pictures of distant wars? Will not things seem closer to us if they are brought into our homes? Will we not be more likely to take part in things that happen in distant countries?

The thing to ask ourselves is how to make the new means of transportation and communication best serve us. We want them to give us safety, as well as comfort, convenience, and speed. We want our new inventions to help us build a better environment, a better nation, and a better world in which to live.

Problems of Communication. I. Speakers on the radio often try to influence the opinions of their listeners. How can we teach people to be on their guard against wrong influences which may come into their very homes through these new means of communication?

II. Look in *Compton's Pictured Encyclopedia* or some other new reference book for information about television and the photoelectric eye. After reading on these subjects, be able to discuss their operation and their value.

III. Would you like to have a television set in your home? Make a list of several programs which you would like to watch by television.

THINKING IT OVER

Perhaps you would like to talk over this matter of transportation and communication with your teacher and your classmates. Below are some problems which you may like to discuss.

I. Why have people been so slow in getting the means of transportation and communication which we now have?

II. What are some of the ways in which the matter of safety has kept people from improving their methods of travel?

III. What are some of the ways in which the matter of cost has kept people from improving their ways of travel?

IV. Why can we say that comfort was the first need of people in getting means of travel and that it has always been the most important need?

V. Before people had learned how to travel very rapidly and to communicate very rapidly, they could only wish that they could do these things. What are some of the stories which tell about their wishes?

VI. If you could travel all you wanted to, where would you go? What would you like to see? By what means would you prefer to travel?

VII. Will air travel be safer when people learn to travel high in the air? A woman told her son that she would not worry about him so much if he would only fly low and fly slowly. Was she right?

UNIT III

CONSERVING OUR NATURAL RESOURCES

Section I. This Land of Ours . . . page 269
Section II. A Story of Beginnings . . page 296
Section III. Discovering a New Storehouse . . . . . page 322
Section IV. Our Farms and Our Forests page 333
Section V. Treasures in the Earth's Crust . . . . . page 371
Section VI. Plans for the Future . . page 393

I. THIS LAND OF OURS

You live in the United States of America, one of the great countries of the world. What do you know about the country in which you live? Do you know the extent of its land? Do you know how much of its land is rich, fertile soil? Do you know the value of its forests and mines and oil wells? Do you know how these treasures of our country have been used, and are being used, by the people of the United States?

THE MOST FORTUNATE NATION IN THE WORLD

There are more than two billion people living upon the earth today. They live in groups known as nations. The people of a nation live under one government. Usually they speak the same language, have the same customs, and have much the same interests. Some of the nations of today are small, and some are large. Some are fortunate nations, having much wealth, and some have little wealth.

Each nation owns the land which lies within its boundaries. It owns the forests, if forests grow on the land. It owns the metals and fuels and precious stones which lie under the soil. It owns the fish which swim in its lakes, rivers, and harbors and in the seas along its coasts. It owns the wild life of the fields and forests and swamps.

We call the soil, the waterways, the forests, the minerals, and the wild life the *natural resources* of a land. *Resources* are things which men can use. We say these things are *natural* resources because they are supplied by nature.

Some of the nations of the earth are most fortunate in having rich and plentiful natural resources. The soil is fertile enough for the production of wheat, cotton, rice, or other crops which the people need. Many valuable ores — iron, copper, zinc, lead, gold, silver — lie beneath the soil. Fuels are there — petroleum, gas, and coal. Large forests grow on the land, furnishing wood, protecting the soil, and helping to preserve the supply of water. Waterfalls in rivers produce abundant water power. Lakes and rivers and forests and mountains are filled with wild life — with fish, wild animals, and birds. The people of a nation blessed with such resources are, indeed, very fortunate!

Other nations are not so fortunate. It may be that the resources of the land have become exhausted or wasted in some way. It may be that the metals beneath the soil are not valuable, or that they are difficult for men to reach. It may be that the fuels are scarce. It may be that the soil is thin or stony, or that forests are lacking. Sometimes it may be all of these things. The people of a land that is not rich in natural resources find it hard to get the food, clothing, and other things necessary for their comfort and convenience.

Do you know the most fortunate nation in the whole world? If you do not know, you will be surprised, for you belong to that nation. The United States of America is the richest nation in the world. Why? The people of the United States have made use of their natural resources. They have cultivated the land and raised crops of different foodstuffs. They have developed the waterways and the water power. They have made use of the minerals, the metals, and the fuels. They have drawn upon the fish for food and upon the wild life for food and fur. The natural resources have provided the people with raw materials for their industries. Out of the raw materials have come all of the things which make the people comfortable and happy.

Do you wish to understand this country of ours? Do you want to help preserve its wealth? If you do, you must learn much about the land. You must know about our natural resources, and you must know the story of how our people have used them. If any of them have been exhausted or wasted, you must try to see what must be done to restore them or to use what remains wisely.

The Natural Resources of Your Community. I. Look about you. Are there woodlands within sight? Are there farmlands? Are there rivers or lakes? Is there wild life? Are there mines or oil wells? Make a list of all the kinds of natural resources you can discover. Place a star beside the one which you think is most important to your community.

II. Think of all the occupations or industries which are carried on in your community. What natural resources does each of these occupations depend upon? Make a chart showing this information. Be sure that your chart is planned to present the information clearly. Head one column *Occupations* and a second column *Resources.* Make your chart in such a way that you can add more information as you learn more about natural resources.

Using Words Correctly. Give examples of the following to show that you know the meaning of each term: *natural resources, mineral, metal, stone, fuel, soil, wild life.*

Comparing. Think about the nations of the world which you have already studied. Which of these would you say have rich natural resources? Which have poor natural resources? Make a chart showing the natural resources of two or three countries in which you are most interested. In the first column list the names of the countries. Head other columns: *Soil, Vegetation, Minerals, Fuel, Water, Wild Life.* Perhaps you will need to read in your geographies to get the facts.

Starting a Museum. Perhaps your class would like to start a Museum of Natural Resources for the school. If you would, these are some of the problems which will come up and which will have to be settled: (1) Where will the Museum be located? (2) What arrangements can be made to keep the exhibits safe and, at the same time, place them so that they can be seen? (3) What are good ways of exhibiting specimens of stones, ores, grains, woods, soils, and so on? (4) How can the work be planned so that everyone in the class can have a part in making the Museum?

THE GREAT SIZE OF OUR COUNTRY

Our country reaches from the Atlantic Ocean on the east to the Pacific Ocean on the west. That is a distance of nearly three thousand miles. It stretches from Canada on the north to Mexico on the south. That is a distance of about sixteen hundred miles. It occupies nearly one half of the continent of North America.

Within the boundaries of the United States are nearly two billion acres of land. That is more than three million square miles of land. Does the size of our country have anything to do with its prosperity? It has much to do with it. The stretch of about sixteen hundred miles from north to south gives the country great differences in temperature. Within the three-thousand-mile distance from east to west the country has a wide range of moisture conditions. Over the wide expanse of more than three million square miles of territory may also be found many differences in the soil and in the surface conditions of the land.

These great differences in temperature, moisture, and soil make possible great variety in crops. Take, for example, the three crops — cotton, corn, and citrus fruit. Each requires its own type of climate. Each requires its own type of soil. Cotton requires a growing season of two hundred days without frost. It needs at least twenty inches of rainfall during the year. Such conditions can be found in

our southern states. Corn requires one hundred fifty to one hundred eighty growing days, with warm days and nights during much of that time. It needs abundant rainfall during the summer, but a dry autumn. Such a climate can be found in some of our central states. Citrus fruit requires a long and warm growing season and plenty of summer moisture. Such conditions can be found in our states of California, Texas, and Florida.

Every section of the United States adds its share to the wealth of our country. Some sections contribute fuel. Some contribute meat and milk. Some sections contribute minerals; some, grains; some, fruits; some, lumber. Some contribute water power; some, stone; some, fish.

To see how important its size is in making the people prosperous, try to think of our country as reduced in area. Take away a strip of territory from the northern part of the United States. What do we lose? We lose the great iron and copper mines of Michigan and Minnesota. We lose one of the greatest inland waterway systems in the world — the Great Lakes. Take away a slice of land to the south, and we lose the cotton fields of Texas, the citrus fruit groves of Florida, and the oil fields in Louisiana and Texas. It takes the whole extent of our territory to make us the prosperous country that we are today.

The size of the United States has given us our important position among the nations of the world.

It has made our country independent. It has helped to make the United States a world power. It has made our comfort, our happiness, and our high standard of living possible.

Size and Natural Resources. I. Look at a map of the world and select two countries which seem to you about the size of the United States. Then discover how nearly right you were in your selection by finding, in your geography, the area of each of the countries. Are these countries as prosperous as the United States? Do their inhabitants live as well as we do? Why or why not?

II. Explain how the size of the United States helps in giving us a variety of foods.

III. Select one of the smaller countries of the world — Japan, Denmark, or Switzerland. Find out: (1) whether the country has varying temperature and moisture areas, or whether the climate and soil are about the same in all parts of the country; (2) what variety of natural resources it has. Compare this country with the United States, and decide whether the size of the country has anything to do with the wealth and variety of natural resources.

IV. Begin work on a *Natural Resources* map of the United States. Draw a large map in outline, filling in the mountains, rivers, and lakes. Color the map in light shades to show the different temperature and moisture areas. Then work out some means by which you may show the location of forest, mineral, and fuel areas; of our different crop areas; and of wild-life areas. Plan to add to this map as you find more information about our natural resources.

THE SURFACE OF OUR LAND

If you were to fly in an airplane from the east coast of the United States to the west coast, you would see a panorama of ups and downs. Over swamps, mountains, plateaus, plains, and valleys you would fly, for the surface of the land in the United States is, indeed, irregular.

Your trip would start at the Atlantic seaboard. As you flew westward, you would first see only low plains, rising but a few feet above the water. Indeed, in many places the coastal land is so low that it is swampy land and is unfit for cultivation. A few miles westward, however, you would see the Appalachian Mountains below you, and beyond the mountains you would pass over the Allegheny Plateau. Beyond the plateau you would fly for hours over the low level plains of Ohio, Indiana, and Illinois, which are in the eastern half of the Mississippi Valley. These plains slope westward — a steady, gentle slope down, down, down to the great Mississippi River. You would notice that the rivers flow westward to meet the Mississippi River.

It would take but a few moments of time to cross the great river in your plane. On the other side of the river the land begins to slope upward again, and the rivers flow eastward to meet the Mississippi.

But the plains west of the Mississippi River do not differ much from those east of it. On you go, westward over Iowa, over Nebraska, and across the

Wyoming state line. There the Mississippi Valley ends and the Rocky Mountain region begins.

All of this time you have been flying low so as to see the land. Even while crossing the Appalachian Mountains, you were flying fairly low, for those mountains are old and worn down. But now your plane must mount much higher into the sky. Great peaks rear their heads into the clouds, and to pass over them, you must travel above the clouds.

Beyond the Rocky Mountains you cross the Great Basin of Nevada, with its bunch grass, sagebrush, cactus, and grazing cattle. Then, again you must take your plane into the clouds, for more mountains are ahead of you — the mighty Sierra Nevada which joins the Cascade Range. Beyond this high range you fly for a few miles over the broad rich valley of California. Finally, crossing the last mountain ranges, and the highest of them all, the Coast Ranges, you reach the Pacific Ocean.

What a panorama of heights and depths has met your eyes! Such fertile, luxuriant valleys! Such monotonous, treeless plains and plateaus and such barren deserts! Such slopes and peaks and rocky cliffs and deep, deep canyons! At one point you caught a view of farmers plowing their level prairie fields. A few miles beyond, you saw sheep grazing peacefully on the mountain slope. Then you looked down, down, down into a mighty canyon, scooped out by the rushing water of a mountain torrent years and years ago.

Philip D. Gendreau

TOWERING PEAK AND QUIET LAKE

Black Star

MIGHTY MOUNTAINS

Resettlement Administration Photograph by Jung

FERTILE SLOPES

Ewing Galloway

WIDE PRAIRIE

Ewing Galloway

DESERT WASTE

Soibelman Syndicate

TROPICAL SWAMP

H. Armstrong Roberts

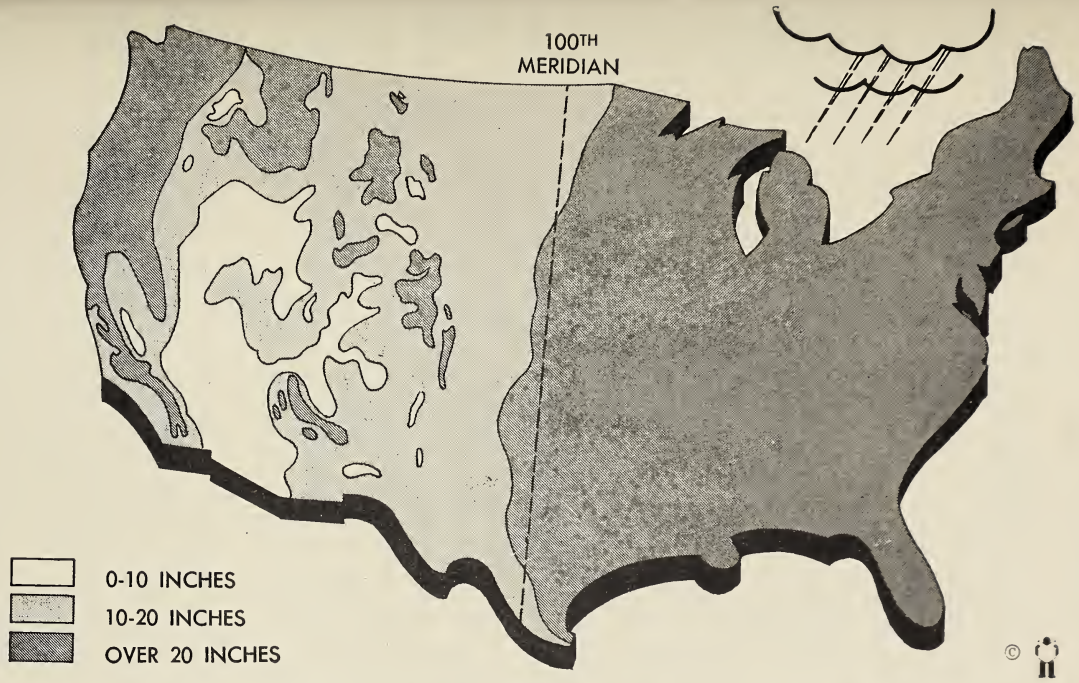
MAJESTIC WATERFALL

Ewing Galloway

PEACEFUL RIVER VALLEY

A MAP SHOWING THE SURFACE FEATURES OF THE UNITED STATES

Study this map by trying to imagine you are taking the airplane trip described on pages 276–277. You might ask someone to read those pages aloud as you follow the route on the map.



A MAP SHOWING RAINFALL AREAS IN THE UNITED STATES

Study the rainfall areas by the use of the Key. Then find on the surface map facing this page the region of the greatest rainfall; of little rainfall; of the least rainfall. What kind of vegetation would you expect to find in each of these rainfall areas?

Does this irregular surface of the land of the United States have anything to do with the prosperity of the country? It has much to do with it, as we are finding out.

One of the big problems of our country today is the saving of the soil on the sloping surfaces of the land and the control of water which falls on these slopes. The people of our country have made changes in the surface of the land. They have cut down forests and plowed up grasslands. They have built dams in streams and altered the courses of rivers. They have done these things without thinking of the results, and some of the results are serious. If the surface of our land were flat and level, perhaps cutting down forests, damming rivers, and plowing up grasslands would not have mattered much. But the irregular surface of land cannot be altered without bringing about great changes. We have begun to discover this fact. The rest of this story will help you to learn what changes have been made by our people and what damage has been done.

Maps and Pictures. I. From a relief map of the world, find out which countries are: (1) mostly mountainous; (2) mostly flat. Do you think these countries suffer from not having the variety of land surfaces that the United States has? Explain your answer.

II. Make a collection of pictures showing the great extremes of land surface in our country. Include pictures of mountains, peaks, plateaus, valleys, and canyons.

THE USE OF LAND

In our country a landowner may decide for himself how he should use his land. One landowner may be a farmer, using his land to raise crops. Another landowner may be a stock raiser, using his land to raise herds of animals. Another man may own forest lands, using his forests to produce lumber or other forest products. Another owner may lease his land to an oil company which may extract petroleum from the ground. Another landowner may find coal beneath the surface of his land and may sink coal mines on his land. Still another owner may possess land near a prosperous city and may, therefore, divide it up into building lots. There may even be a landowner who may choose to let his land lie idle.

Usually, owners want their land to make money for them. Sometimes, in their eagerness to make a profit, they do not think how they may make the most intelligent use of their land. To many people in our country, farming seemed the best way to make a profit from the land. So they cut down forests to clear the land for farming. They plowed up the grasslands, which were fine for raising cattle, and turned them into farms. Then, when it was too late, they discovered that the forests were needed to protect the soil and to keep the water from washing the soil away. They discovered that the grasslands were not suited to farming.

From their mistakes the people of this country have learned that it is wise to study the land — to find out what soil is best for farming, what soil is best for pasture lands, and where forests must be kept to protect the soil.

Three hundred years ago anyone could have all the land he wanted. He did not have to buy the land. Land in this country had little sales value because it was plentiful. Today, good farmland may sell for over three hundred dollars an acre. Why is this true?

Partly because men have improved farmlands. They have cleared the land. They have built roads and buildings. They have fenced the fields. They have fertilized the soil and killed off weeds. They have irrigated the land. They have learned what crops grow best in certain climates and in certain soils. They have learned what crops will find the best markets. They have learned how to breed animals and raise better stock. All these things have added to the value of farmlands.

The increase of population has also added to the rise in land values. We say that land is scarce today; but we really mean that there are more people in the country today who want land than there were three hundred years ago. As our population has increased, there has been a greater need for food. As the need for food grows, there is more profit in raising food. For this reason more people want to own land, and the price of land has increased.

The building of cities has increased the price of land. Land lying near great cities is more valuable because it is near good markets. The building of great irrigation dams has added to the value of the land around them, for irrigated land will raise more valuable crops.

The farmers of the country have helped to build up other industries. Food factories have been built in all parts of the country. The meat-packing and the dairy industries have increased. Stores and markets have sprung up. Transportation lines have been built to carry food to all parts of the country.

The people of the United States have almost two billion acres of land. More than half of this land has been turned into farms. There are more than six million farms in our country. Over ten million of our people earn their living by raising crops and animals. Still other millions make their living by working in food industries. Do you see how much depends upon the correct use of our soil?

Using Land. I. Make a list of the ways in which the land near your home and school is used. Then tell what most of the land is used for.

II. Try to decide what land in your neighborhood could be put to better use.

III. Make a class chart showing all the uses of land. Try to make this list very complete.

IV. Find out what land is the most highly priced land in your vicinity. Why is it so valuable?

THE USE OF FORESTS

Our forests earn millions of dollars for us each year. Why are our forests of value to us?

Wood is used more than any other material in the construction of houses. At present over sixty per cent of the lumber produced in the United States is used for building purposes. About one half of this amount is used for farm buildings. The other half is used for city homes and industrial buildings. Yet houses made of wood are usually small, for large wooden buildings are considered unsafe because of the danger from fire.

The second great use of wood is in the making of furniture. Almost all furniture is now made from wood. Furniture, like clothing, changes its style; so people frequently buy new furniture.

About ten per cent of the wood used in manufacturing is made into railroad cars and ties. Both passenger and freight cars are made in part from wood. The railroads need so many ties on which to place their steel rails that some railroad companies own forests and hire woodsmen to make their ties.

The paper manufacturers use great quantities of wood. Acres of forests are felled each year to produce the enormous amount of paper we use in newspapers alone. But perhaps wood will not always be used for making paper. Scientists are now experimenting to discover whether we cannot make paper from cornstalks and other waste materials.

The manufacture of containers consumes a great deal of wood. Boxes, crates, paper bags, barrels, kegs, tubs, buckets, dishes, and baskets are all made of wood. Crates are used for shipping fruits, vegetables, vehicles, toys, furniture, machines, and many other things. Barrels hold flour, molasses, vinegar, salted meats, salted fish, fruits, and vegetables. Tubs are used for packing butter, lard, olives, and fish. Boxes are used for holding all kinds of merchandise and, whether they are wooden boxes or paper boxes, they come from the forests.

Wood is made into countless other things of use — telephone poles and fence posts; matches and toothpicks; boats and masts and oars; baseball bats and tennis rackets; toys and picture frames and pencils; kitchen utensils, handles for tools, beads and buttons; bridges and docks and sidewalks. Wood is used for fuel and in the manufacture of rayon. Wood is one of the most important products of the soil.

But other forest products besides lumber add to the value of our forests. The sap and gum of trees are valuable products. Each spring, in the New England states, the sap is collected from the maple trees at the time that it begins to rise in the tree. A hole is bored through the bark of the tree to the sapwood. A spout is placed in this hole, and a bucket is hung on the spout. Each day the sap buckets are emptied and the sap taken to the sugarhouse. There it is boiled until it is just thick enough for making sugar or sirup. The sirup is bottled and the sugar packed

in containers. The maple-sugar industry supports a number of people in the United States.

Turpentine and resin are made from the gum which comes from the longleaf or slash pine. The gum is collected and carried to a still, where it is cooked in closed retorts. The turpentine passes off as vapor and then is condensed into oil. Turpentine is used in making paints and varnishes; crayons, explosives, patent leather, celluloid, and medicine; and waterproof cement for glassware, rubber, and metals. The part of the gum left after the turpentine has been taken out is called resin. Resin is used in manufacturing paper, in making soap, and in building ships.

Each year men turn the gum which they take from the pine trees into millions of dollars. Finally, after the trees will yield no more gum, they can be cut down and used for lumber.

What numbers of trees it must take to make so many products! What millions of dollars of profit are produced by our forests!

The Forest Industries. I. List the things in your household which are made from wood. Classify these in some such way as: *furniture, tools, utensils.*

II. Not all of the forest products of our country have been mentioned in the story which you have just read. Find out about other forest products.

III. Find out how paper is made from wood.

IV. What are hardwood trees? Name some kinds of hardwood lumber and tell for what each kind is used.

OUR WEALTH IN METALS AND FUELS

The use of our wealth buried in the earth's crust has brought about a new age in the United States. What are the signs of this new age? Moving belts, turning wheels, and purring engines; the sounds of grinding, scraping, polishing, sliding, pounding, drilling, and welding; steel derricks, copper wires, lead pipes, steel rails.

All this change has come about because the men of our country have learned to take the useful metals from the earth and to make them into machines; because they have learned to take the fuels from the earth and turn them into power. This new age is an age of strength and swiftness and endless motion — an age of metals and power.

Of all the wealth stored beneath the surface of the earth today, six products are of most importance to our country. What are these six products?

The first is *iron*, which can be made into steel — steel for making machines and the engines to move them; steel for making buildings; steel for making tunnels and bridges and vehicles. The second is *coal* for making power to run steam engines. The third is *petroleum* for making power to run engines and for the lubrication of all machines. The fourth is *copper* for making wire over which travels the electric current. The fifth is *lead* for covering cables and making pipes. The sixth is *zinc*, which is used chiefly in combination with other metals.

Our country has vast stores of these six important products. It produces over one third of the world's coal, about two thirds of its oil, over one third of its iron, one fourth of its copper, almost one third of its zinc, and one fourth of its lead.

Mineral Wealth. I. Find out from an encyclopedia, or from your geography, or from some reference book like the *World Almanac*, the mineral products that are to be found in this country, and the value of our yearly output of each mineral. Perhaps you can find maps showing where deposits of these minerals have been found.

II. Tell whether the following are mineral products: granite, concrete, glass, bricks, pottery, crystal, bronze, asbestos, aluminum. Find out how at least one of these is produced, and report your findings to the class.

III. In an encyclopedia find all the products made: (1) from coal; (2) from petroleum. On pages 372 and 378 you will find maps showing where these two important fuels are found in our country.

DEVELOPING OUR NATURAL RESOURCES

How do the people of the United States turn their natural resources into things of use? They do it by means of knowledge and labor and skill. The people of the United States have always been good workers. The first settlers were strong and vigorous and intelligent. They had endurance and determination and courage. They had the same standards of

living as the people of civilized European nations; that is, they wanted good food, comfortable houses, good clothing, and many of the conveniences of living. And they were willing to study and plan and work in order to supply these wants.

The people in our country today have many wants. Because they wish to supply their wants, they are willing to take plows and go out and cultivate the land. They are willing to go down into deep caverns under the earth and mine the coal and metals. Labor is one of the most important factors in developing the natural resources of a land.

But it takes more than labor to change natural resources into things of use. It requires skill, too. The Indians had strength and courage and endurance, but that was not enough. Besides labor, it takes skill to make the best of what we have.

The people of the United States today have wonderful machines to help them with their work. The machines can do some things that even the hands of man cannot do. By means of our wonderful machines men can turn raw metal into delicate watch springs; they can produce houses, furnishings, oils, medicines, and foods from our forests; they can produce fuel, tools, and vehicles from our minerals; they can raise food products on our rich farmlands. The men and women and machines of the United States are equal to these tasks.

But even labor and skill and machines together cannot make full use of our natural resources.

It takes knowledge, too. The people of the United States have knowledge. They attend great universities where they are taught to think about their ways of working. They have scientific laboratories in the universities and in industrial plants and in some departments of our government. In these laboratories men constantly experiment to learn the best ways of using our natural resources. They study plant and animal diseases. They study how to control pests. They learn how to feed and care for animals and how to breed fine stock. They learn how to restore worn-out soil and how to enrich poor soil. They study the best ways of mining ore, of building dams and bridges, of fighting forest fires.

The people of the United States are students. They are thinkers. They are skilled workers. They are hard workers. They have tried to find the best ways of using our national resources.

Reading about Natural Resources. Look in the following books for information about our natural resources:

North America by Plane and Train by Alison E. Aitchison and Marguerite Uttley

Our Home State and Continent by Albert R. Brigham and Charles T. McFarlane

How the World Supports Man by Dorothea H. Davis

Conservation Reader by Harold W. Fairbanks

Vanishing Wilderness by F. R. La Monte and M. H. Welsh

Nations and Resources. I. Holland is a country small in area but densely populated. Yet the Dutch people have a high standard of living. Read all you can about Holland in your geography or in an encyclopedia. Then answer these questions: (1) What are the natural resources of Holland? (2) In what ways do the Dutch people show that they have intelligence and skill in making the most of their natural resources? (3) How does Holland get certain things which she wants and needs but which her own land does not produce?

II. Read all about Arabia in your geography. Then answer these questions: (1) What are Arabia's natural resources? (2) Is there any connection between the resources of Arabia and the standard of living of the Arabians?

III. Read about the most primitive people of whom you know. Are they primitive because of a lack of natural resources? If not, why are they still primitive?

Whose Resources? I. Forests can be cut down or burned away. Can an iron mine be exhausted? Can oil wells be drained dry? Does soil remain good forever?

II. Suppose the Indians had exhausted the mines and forests before white men came to our continent. What work would white men have been doing during the 330 years since they settled in this country? How would they have supplied their wants?

III. We of our generation are heirs to a great fortune in natural resources. Is it enough for us to work hard to supply our own wants? Do we owe anything to the generations that follow us?

II. A STORY OF BEGINNINGS

What is the origin of the natural resources found in such abundance in the United States? Scientists who have tried to discover how the minerals, fuels, soil, plants, animals, and water came to be are not able to explain these things fully. They can tell us only what they believe to be true. You will learn some of their ideas as you read the following pages.

HOW THE EARTH BEGAN

This is a story of things that happened millions and millions of years ago.

It is thought that the mass of material which makes up the earth today once belonged to the sun. Scientists believe that ages ago this mass of material broke away from the sun and shot out into space. At the time this happened, the sun was a ball of hot, gaseous matter, just as it is today. And so, of course, the part which shot off from the sun into space was hot, gaseous matter, too. This part was our earth, but it was not at all like the earth as we know it today.

As this mass of burning gas flew through space, it took the form of a ball because of its whirling motion. In time, the outside of the ball began to cool. As it

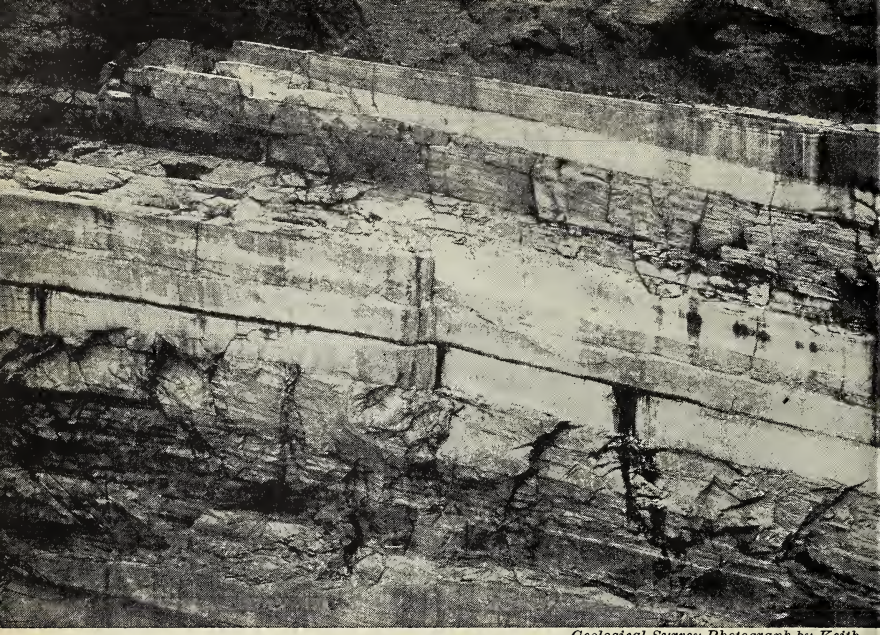
cooled, some of it changed from a gas to a liquid, and then from a liquid to a solid in much the same way that water becomes solid when it freezes.

Only the outside surface of this ball of burning, gaseous material became solid, however. The mass inside of the ball remained hot. The cooled outer surface formed a crust around the hot interior of the ball. This crust we call *rock*. The rock crust is hard, heavy, and solid. It is difficult to break.

The crust of the earth has many different materials in it. Some of it is iron, and some, copper. There are also gold and silver in the crust. The materials of the crust are all mixed together, for they were mixed together as they hardened.

Many scientists believe that at first the crust of the earth fitted smooth and even over the inside mass, just as the skin of an apple fits when the fruit first comes from the tree. But, as ages went on, the inside mass became cooler, too. As it cooled, it hardened; and in hardening, it shrank. It is the nature of many things to shrink as they grow cold. This shrinking caused trouble, for the outside crust no longer fitted so well over the inside mass of the earth as it once had. The outside was too large for the inside. But the crust could not become smaller, for it had already hardened.

So, it is believed, space was left between the crust of the earth and its interior mass. Probably the space was greater in some places than in others. Probably, too, the crust was not so strong and thick



Geological Survey Photograph by Keith

LAYERS OF MARBLE AND LIMESTONE

in some places as in others. What do you think happened? Just what you might expect. At those places where the crust of the earth was weak, it caved in. We say the crust of the earth *folded.* That means that the outside solid covering bent, making wrinkles something like the wrinkles which form in the sleeve of a coat that is too large for you, or in the skin of an apple that is drying up.

Some of the wrinkles, or folds, which were formed in this way stood up very high. It is thought that these higher wrinkles formed mountains. Between the folds the crust pushed down to fill the huge spaces below the crust, making great hollows. These great hollows became the oceans.

Geological Survey Photograph by Keith

FOLDED ROCK LAYERS

As time went on, the crust of the earth probably folded again and again. As the cooling and shrinking of the inside mass continued, the outside crust changed, too. Such foldings of the solid rocky crust of the earth must have been terrible events. The earth shook and trembled. Huge cracks appeared in the ground. Deep rumblings came from far, far below the surface of the earth. Such disturbances are called earthquakes. During an earthquake the crust of the earth shifts from one position to another, some parts pushing or sliding upward, some parts sinking. The crust of the earth is still shifting. There is hardly a day when an earthquake does not occur at some point on the earth's surface.

If you will look at a relief map of the world, you will find the location of the mountains which have been formed in the earth's crust. But these mountains were not all formed at one time. It took many earthquakes and many millions of years to make such huge changes in the crust of the earth.

The map will also show you where great bodies of water lie. These oceans and seas are the sunken parts of the earth's crust — the parts that settled down. In time, these great hollows became filled with water. There is more water than land on the earth's surface, because more of the earth's crust sank down than was pushed upward. Some of the hollows on the surface of the earth are very deep. For example, there is one place near the Philippine Islands where the ocean is over six miles deep.

It took millions of years for all these changes to take place. Some of them happened so long ago that the mountains formed by the wrinkling have had time to become worn down until today they are entirely gone. Other mountains are not nearly so high as they were when they were first formed. The ridges in the eastern part of the United States, the Appalachian Mountains, were made long before the folds which form the western mountains were made. Some of the ridges of the Appalachian Mountains are so old and so worn that they seem more like hills than mountains. The mountains along the Pacific coast are the youngest mountains in the United States. They stand very rugged and

tall. The Rocky Mountains are middle-aged. They are not so old as the Appalachian Mountains, nor so young as those along the Pacific coast.

When the crust of the earth folded, it sometimes cracked. When that happened, the lower layers of rock were exposed. This breaking of the earth's crust has made it easier for men to find the minerals buried in the lower layers; therefore, much of the mining of minerals takes place in the mountains.

The United States is rich in its mineral resources, as you have already found out. Huge beds of iron, copper, gold, silver, zinc, and lead ore lie hidden underneath the soil or buried in rocky crust. These minerals are among the most valuable natural resources of the United States. They can never be replaced. Once taken from the soil, they are gone. Forests and other crops can be replanted. Fish and other animals will replace themselves if they are allowed to live under suitable conditions for producing their young. But minerals cannot be replaced. They came from the sun, countless millions of years ago. Should we not see to it that our minerals are used wisely?

The Origin of the Earth. I. Scientists do not all agree as to the origin of the earth. See whether you can find some explanation as to how the earth originated other than the one given in the story you have just read.

II. Find pictures showing folds in the earth's surface. Where might you look for such pictures?

III. Explain what minerals are and how they were formed in the earth's crust. Tell why our mineral supplies should be used wisely.

This Changing Earth. I. Earthquakes tell us that the earth is still changing. Bring to class news of a recent earthquake. Tell where it was and what happened.

II. You know that there are such things as volcanoes which send forth, from the interior of the earth, hot gases, smoke, and lava. Find out about volcanoes and what causes them. Explain how they act. (A coffee percolator will help you in your explanation.) Are volcanoes part of the story of the changing earth?

III. Find out about hot springs, such as we have in Yellowstone National Park. Explain what causes them.

HOW SOIL IS FORMED

When the crust of the earth was formed, it was bare rock. Nothing grew on the earth at that time. There was no mud or sand or clay for plants to grow in. There was no soil of any kind. How does it happen that we now have soil over almost all parts of the earth? What is soil? How is soil made?

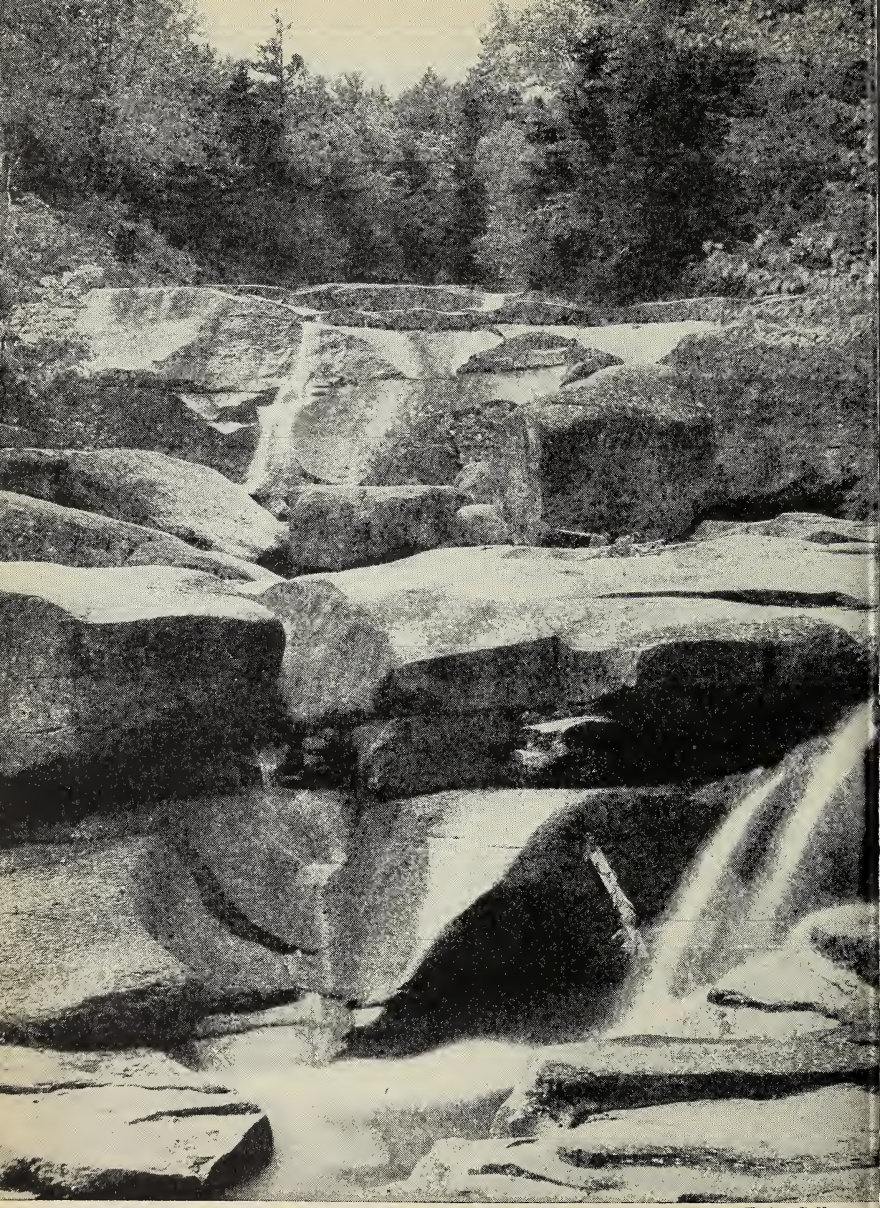
Soil is ground-up or decayed rock, mixed with decayed plant and animal life. The first step in making soil is the grinding of the rocks into rock powder. The process of grinding up rock is called *erosion*. The second step is the mixing of this rock powder with decayed plant and animal matter. How has all this work of preparing soil been done?

Making soil is a slow process. It is made with tools which do not break nor grow dull nor become old-fashioned. The tools are the forces of nature which operate without ceasing. So the making of soil is a continuous process.

Rain falls upon the rocky surface of the earth. Water gathers in the hollows or crevices of the rock. In the water are acids which dissolve some of the cement that holds the harder particles of rock together. Rock particles are loosened from the mass of rock, and the next falling rain washes them down the slopes toward hollows in the earth's crust.

Often water freezes in the crevices of the solid rock. As it freezes, it expands — grows bigger — and cracks off pieces of the rock, just as water freezing in a glass will crack the glass. As the broken-off bits of rock slide down the rocky slopes, they are ground into smaller bits until they become tiny particles.

You probably know that much of the moisture which falls on the earth comes down as snow. Snow, packing to great depths in the mountain canyons, becomes a mass of ice. Often such a mass of ice starts to move down the slopes in a river of ice called a *glacier*. A glacier slides down the slopes very slowly; but as it moves, its great weight breaks off jagged rock masses. It carries along these broken pieces of rock, scraping and grinding them against the rocky slopes every inch of the way until they become pebbles and even grains of sand.



Ewing Galloway

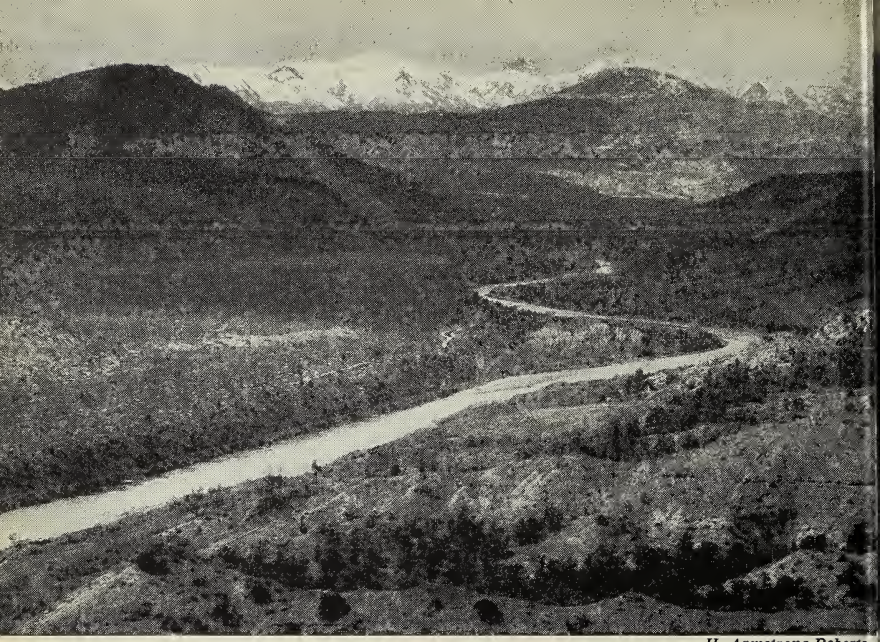
WATER EROSION

The constant action of the tiny streams of falling water wears grooves and channels in the solid rock.

Philip D. Gendreau

GLACIER EROSION

What appears to be a wide road down the mountain slopes is a mighty river of ice, grinding out a canyon in the earth's crust.



H. Armstrong Roberts

WATER EROSION

The slow-moving river does its part in carving a wide valley.

You have noticed how the water and ice carry the rock particles down the slopes into the hollows of the earth's crust. In some of these hollows are rivers. The rivers flow on to the sea, carrying bits of rock in their currents, grinding them against the rocky river bottoms, and wearing them into still smaller bits. Moving currents of water continue always to do their work of grinding rock into rock powder, to become soil.

Some of the rocky bits reach the sea. Here they are caught up by huge waves which hurl them against rocky shores and cliffs. What happens? More particles are cracked or ground from the solid rock.

Ewing Galloway

WATER EROSION

The force of pounding waves helps to break up a rocky coast.

Water, whether it be in the form of falling rain, or flowing rivers, or dashing waves, or sliding ice, does its share of the work of erosion.

Heat and cold are strong forces of nature which do their part in soil making, too. In the daytime the hot sun beats down upon mountaintops, heating the rock mass to a great heat. The sun sets, or clouds shut off its rays, and perhaps a sudden change in temperature sets in. The rapid cooling cracks the rock, breaking off bits. These bits slide down the slopes, often carried down by the next rain.

The wind blows. It carries with it rock particles which it has picked up in places where soil has

gathered. The particles are as sharp and as hard as bullets. The wind hurls these tiny pieces against the rough surface of a great boulder. Year after year, century after century, this battle between the winds and the rocks goes on. Constantly, the surface of boulders and rocky slopes are pelted by tiny bullets which grind off bits of rock. The pieces that break off and fall to the ground are rock powder. The wind is one of the strongest forces of erosion.

Plants and insects help in the process of making rock powder. They pry and pull and push and bore, moving about the tiny rock particles and making the surface of the soil rough. They add their work to the work of the wind, the water, the ice, the frost, and the sun.

In these ways the forces of nature grind up the rocks into powder. But this is only part of the process of making soil. There is another part which is just as important. Tiny rock particles alone are not soil. They must be mixed with decayed plant and animal matter to become soil. Plants grow up, bear seeds, and die. The decayed roots and stems and leaves mix with the decayed rock powder. Animals — birds, fish, beasts, insects — eat the plants. They grow up, bear their young, grow old, and die. Their bodies, too, decay. This decayed animal life mixes with the rock powder, too. Then what do we have? Soil! The greatest source of wealth that a country can have! Soil on which human life must depend!

Black Star

WIND EROSION

Sand-laden winds helped to carve these natural rock pillars into fantastic shapes.

H. Armstrong Roberts

SCULPTURED ROCK

Notice the heaps of rock powder at the base of each eroded cliff.

Soil is by far the most valuable of all the natural resources. If it were not for soil, we would have no food. Neither plants nor animals can live without soil, and without plants and animals there can be no human life.

Soil covers most of the surface of the earth. In some places it is only a few inches thick. In other places it is many feet thick. The older the earth grows, the deeper becomes the soil. Day after day, and year after year, the process of soil making continues. For countless ages, ever since the crust of the earth was first formed, the making of soil has been going on.

Soil is of many kinds, depending upon the kind of rock from which the soil particles came and the amount of decayed plant and animal matter, called *humus*, which is mixed with the rock particles.

Sandy soil is a soil in which there is not much decayed plant and animal matter. The farmer often calls it "light soil." It is not the best soil for farming, but there are some crops that grow well in sandy soil. Since sandy soil is loose, the roots of plants can push down into it easily; yet this very looseness allows the soil to dry out quickly in case of drought.

Clay is a soil made of very fine rock particles that pack close together. Clay is called "heavy soil." When it is wet, clay packs very solid; and when it is dried out, it may become almost as hard as a brick. When clay has enough humus in it, it can become good soil for certain crops.

The best soil for farming is called *loam*. Loam has enough sand in it to keep the rock particles from packing too tightly. It has enough clay in it to keep it from loosening and drying out quickly. It has enough humus and lime in it to furnish plenty of food for growing plants. The black loam of some of our fertile river valleys is the finest soil the earth's surface can offer.

It has taken men a long, long time to find out how valuable soil is. For thousands of years primitive men did not use the soil at all, though they used the plants and animals that depended on the soil. Then finally men learned that they could use the soil for growing plants. But it is only in recent years that men have learned that soil must be handled with care — that improper handling can destroy this soil which is man's greatest source of wealth.

The United States is rich in its soil. It has fertile soil of many kinds, adapted to many crops. It took countless ages to prepare this soil. The people of our country have begun to realize that it is worth their time to study the care and preservation of this great natural gift.

Kinds of Soil. I. Get samples of gravel, sand, clay, and loam. Mark each in some interesting way. These samples belong in your Museum of Natural Resources.

II. Find out whether you may send a sample of soil from your school ground to your State University or to an agricultural college in your state. Ask whether they will

analyze it for you and tell you whether it is good soil for growing plants. If it is not, ask them to explain why.

III. It is said that it takes five hundred years to make one inch of topsoil. Does that help you understand why we should be careful of our topsoil? Have you found any ways in which our topsoil is being wasted? Do you know any method of preventing this waste?

IV. See whether you can find some rock powder which has not yet become soil. Try to raise a plant in it. Make a record of your experiment to place with some of the soil for your Museum of Natural Resources.

THE STORY OF COAL

Perhaps you have wondered how coal ever came to be hidden far down within the rocky crust of the earth. To understand this story, you must go back millions and millions of years. About three hundred million years ago conditions on the earth were very different from conditions today. For one thing, the climate was different. Almost everywhere the air was warm and moist — even in those places which are now so cold that nothing will grow in them. It was then so warm and there was so much rainfall that trees and plants could grow all the year around.

The rain made much of the land boggy and formed great swamps. In the swamps grew giant trees and plants that were not like the trees we know. They were probably more like huge ferns and mosses. Can you imagine ferns reaching sixty feet into the air or moss growing up as high as a house?

American Museum of Natural History, New York

AN IMAGINED SCENE IN A PRIMEVAL FOREST

The trees and plants of these strange forests grew very fast. There was nothing to destroy them, and they grew for long periods of time. The longer they grew, the bigger and taller they became. Leaves and branches fell to the ground and decayed. The trees and plants themselves died, fell to the ground, and decayed. But new plants and trees sprang up, and the forests lived on and on.

During all this time decayed forest matter piled up thicker and thicker over the surface of the ground. As the ages went on, these beds of decaying forest matter became *peat*. Peat is decayed vegetable

matter, formed into a solid mass, which lies near the surface of marshy land. A bed of peat is called a *peat bog*. The peat bogs were a long time forming. At first they were not very deep, but after millions of years they became deeper and deeper.

The surface of the earth kept on changing. In some places the crust twisted and folded. In others the land was worn down to the level of the water. In still other places the land probably sank below the level of the water. In the lowest parts huge inland seas were formed. The seas covered some of the peat bogs. They lay under the great weight of water and, in time, were covered with layers of sand and even rock. The weight of these materials pressed and packed the decaying vegetable matter closer and closer together where it lay baking in the hot interior of the earth. As it baked and decayed, gases were formed. These gases made still other changes in the vegetable matter.

For countless ages this mass of decaying plant matter was slowly being changed by the gases, the heat, and the pressure. Finally nothing was left of the vegetable matter except carbon. The carbon had been formed in the trees and plants while they were growing in the swamp forests. After all the years and all the changes that had taken place, the carbon turned into hard, black, shiny layers of coal. It was not at all like the carbon which the tree had stored up millions of years before. It had become something quite different.

Finally some great disturbance raised the earth's crust above the seas once more. In time it was hard to tell where these great inland seas had been. But scientists find records in the rock layers of the earth's crust, and they know how to read them. Sea shells and the shapes and skeletons of sea animals, called fossils, are sometimes found buried in rock layers high up on a mountain. These fossil records tell the scientists that once this part of the earth's crust lay beneath the ocean or an inland sea. In many places where layers of coal have been found in the earth's crust, the fossils show that those portions of the crust had once been buried under the sea. Many scientists have come to believe that all coal beds were formed as this story has just explained.

It took millions of years to make the great coal beds from which we are now getting our coal. It took unusual conditions of temperature and moisture and pressure to turn the vegetable matter into coal. Probably a time will never come when the conditions of the earlier ages will exist over such large areas. It is true, of course, that coal is forming today, but not in large quantities.

What about our supply of coal? We have used it freely and often wastefully in years past. It has been estimated that the United States has more than three trillion tons of coal still unmined. Can all of this coal be mined? Even now miners are finding it difficult, in many places, to sink their mines deep enough to take out the coal that is there. Should it

all be mined? Perhaps it is wise for the people of today to realize that the coal supply of our country cannot be replaced and that it does not all belong to us. Should not part of it be spared for the millions of people who have not yet been born? At any rate, we must bear in mind that our coal beds are one of our greatest sources of wealth. We must not waste them.

Coal Deposits. I. Make a map showing the coal areas of the earth. How can you account for the fact that coal is found in such a part of the earth as Greenland?

II. Explain the difference between peat and coal. The encyclopedia will help you. Where is peat used today? Was it used much by earlier peoples?

III. Plan a science lesson on coal. Find out: (1) of what coal is made, (2) what happens when coal burns.

Writing the Story of Coal. Try writing the story of the origin of coal in an interesting way. In other books find more information about the formation of coal than is given in this brief story.

THE STORY OF OIL

Scientists do not all agree as to the way in which petroleum was formed. But most of them agree that petroleum is the result of the decay of sea plants, or sea animals, or both. Would you like to know what some scientists believe to be the origin of petroleum?

Much of what is now the United States was at one time under the sea. Countless numbers of sea plants

and sea animals, both large and small, grew in the waters of the sea. At that time the climate was very warm, and the sea animals and plants thrived in the warm air and water. The seas were crowded with them. But while the waters of the seas swarmed with living plants and animals, the bottoms of the seas became covered with dead ones. It is the dead sea plants and animals in which we are interested in this story.

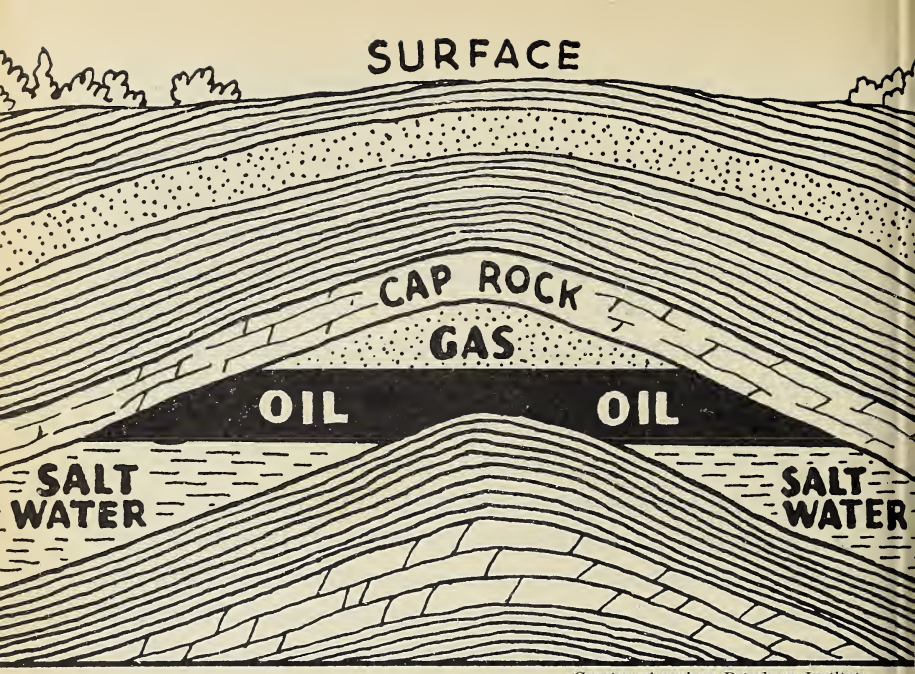
What became of these dead plants and animals? Like all plant and animal matter which has ceased to live, they decayed and became mixed with the soil at the bottom of the seas.

The soil at the bottom of a body of water, called *sediment*, consists of the soil, sand, and rock particles that are washed into the sea with the water which drains from the land. The sediment in many of the inland seas was for the most part made of clay, which forms a thick mud. As the sea animals and plants decayed, the oil in their bodies was caught by the thick, muddy sediment and held fast.

For millions of years this process went on. Sea-weeds and other plants grew up and died, and others took their places. Sea animals of various kinds were hatched in the warm water. They grew up, laid eggs from which their young were hatched, and died. Their bodies sank to the bottom of the sea where they decayed; and the oil was caught by the thick mud and held fast. What countless specimens of sea life met this fate!

Then some great disturbance of the earth's crust lifted these sea bottoms high above the waters. They became dry land and, in time, were covered up with soil. These changes were millions of years in the making. And the sediment which had been collecting for millions of years on the floor of the seas — where was it now? Partly because of the twisting and folding of the earth's crust, which brought these great changes, and partly because of new soil laid over them, the sediment beds now lay far beneath the surface of the earth; and with them was buried the oil from those countless numbers of sea animals and sea plants. Above and below the layer of sediment were layers of sand saturated with salt water. In time, the salt water filtered down, down, through the layers of sediment and sand. The enormous pressure of the earth's crust turned the layers of sand into sandstone and the layer of sediment into shale.

And the oil — what became of it? It turned into petroleum. Some people think that the action of the salt caused this change. Some think that it was caused by the heat inside the earth as well as the pressure from above. At any rate, the change took place. In time, the enormous pressure from above pressed the oil out of the shale, and it was soaked up by the layers of sandstone and limestone which lay beneath the shale. Sandstone and limestone are porous; that is, they have numberless pores, or holes, in them.



Courtesy American Petroleum Institute

DIAGRAM OF AN OIL-POOL FORMATION

For millions of years the petroleum lay in pools beneath the surface of the earth. Some of it seeped up to the surface of the earth through cracks in the rock layers. It was when men became curious about this surface oil that they finally discovered the wealth of oil that lay in pools far beneath the earth's crust.

Such an exciting time that was! The first oil well was drilled in Pennsylvania by Edwin L. Drake in 1859. This oil well went to a depth of 69½ feet. Since then oil wells have been sunk much deeper.

The discovery of oil in Pennsylvania opened up a new industry. Everyone who owned land hoped that oil might be discovered beneath it. Millions of barrels of petroleum were taken from the earth.

It has recently been estimated that the United States has a supply of over twelve billion barrels. This, however, considers only those oil fields already discovered. Nobody knows whether new fields will be discovered or how much oil such fields might yield. Already the oil fields belonging to the United States have yielded over eighteen billion barrels.

Will more oil be formed inside the earth? Probably not. The conditions under which petroleum was formed will probably never return. Under these circumstances does it not seem wise for the people of the United States to guard their petroleum supply carefully against waste?

Books to Read. In these books you will find interesting pictures and stories about the earth:

Along the Hill and *Life Long Ago* by Carroll Lane Fenton

Secrets of the Earth by Chelsea C. Fraser

The Strange Adventures of a Pebble by Hallam Hawksworth

How the World Is Changing by Edith Heal

Before the Dawn of History by Charles R. Knight

Using Terms Correctly. Show that you know the meaning of each of these terms by using it in a sentence: *sediment, oil pool, shale, limestone, petroleum, sedimentary rocks, sandstone, porous.*

Finding Out More about Petroleum. Prepare to explain the origin of petroleum. Make a series of large charts to explain the steps in the story.

III. DISCOVERING A NEW STOREHOUSE

The earth was very old before the natural resources of our continent were put to use by mankind. Civilization was far advanced before our ancestors found this rich store of resources. The story you are now to read tells of the discovery of these new riches and how the people of Europe fought to own them.

IN THE DAYS OF THE INDIAN

Years went by — millions of them. Many times and in many ways the surface of our continent was changed. Mountains reared up and were then worn down by wind and water and frost. Rivers and seas formed and then disappeared. During those millions of years the minerals and fuels in the earth's crust lay untouched.

Plants grew in the soil of our land, and animals fed upon the plants. Many different kinds of animals roamed through the forests, and many kinds of fish swarmed in the waters of the lakes and seas.

Finally a race of human beings, the Indians, came to live on this American continent. They roamed through the forests and shared with the animals the wild plants and the small game. We do not know how long the Indians lived on the American

continent. It may have been thousands of years. But they made few changes in the land. Some of the natural resources they did not use at all, chiefly those that lay hidden beneath the surface of the earth. Others they did use, but they used them only in small quantities.

The Indians learned to value and to use some of the mineral resources — gold, silver, copper, and iron — which they found on or near the surface of the earth. They used stone and wood. They fished in the streams and lakes and hunted the wild life. But the Indians did very little building. They did not have machines, or even the wheel, to help them in transportation. The little farming they did was not harmful to the soil. Probably the continent was changed only very slightly by the Indians, even though they lived on it thousands of years.

In all North America there were not more than a million Indians. Because of their small population and their simple ways of living, the Indians did not make great demands upon the resources of the country.

THE COMING OF THE WHITE MAN

In the fifteenth century civilized men knew only the continents of Europe, Asia, and northern Africa and some of the islands near these continents. Those belonging to the white race lived in the European countries and were the most energetic among the peoples of these continents. They were eager to

know about the various places and peoples in the world and eager to improve their ways of living. They were willing to work and struggle for things they wanted. They were willing to brave dangers and go on adventurous journeys to get the comforts and luxuries of life that they wanted. So there grew up in the different countries of Europe an important group of merchants who made it their business to secure interesting and beautiful things from the far corners of the known world. And, to serve these ambitious merchants, groups of adventurous sea-going men formed fleets of merchant vessels which sailed the sea.

One of the best markets in which to buy silks, spices, precious stones, and fine-woven materials was the faraway country of India, in Asia. Europeans craved these valuable products from India. It was the business of the merchants and the merchant fleets to secure them, no matter what the dangers and hardships.

Now, if you will take a map of the world and trace the route from Belgium, for example, to India, you will see what difficulties existed. A ship starting from the port of Antwerp would sail south down the coast of France and Spain, through the Strait of Gibraltar, and eastward through the Mediterranean Sea. But, notice that finally it would bump into land if it continued to sail eastward; for there was then no Suez Canal to let ships through the land barrier, as there is today. What could the merchants

do? How could they obtain the coveted products from India?

It happened that while the ship would be sailing eastward, a caravan from India would be slowly traveling westward, across Persia, across Asia Minor, to the coast of the Mediterranean Sea. On the backs of the camels were packs containing the precious articles which the Belgian merchants coveted. Perhaps the ship had to wait days and days before the caravan arrived. But finally it did arrive, and some of its precious load was transferred to the waiting vessel.

But all this was a very slow and tedious process. Often it took a merchant vessel six months and more to get its cargo from the East and return with it to one of the countries of western Europe. The little sailing vessels of those days were buffeted about by mighty storms that delayed them. Often robber bands attacked the caravans with their precious freight, and often pirates attacked the ships. All these delays and dangers annoyed the merchants of Europe, who wanted to become wealthy through trade with India.

No wonder, then, that merchants and seagoing men clamored for a new route to India. To find a new route, brave sea captains and their men explored down the west coast of Africa, seeking a road through that mighty continent. But they found none. At last one great explorer, Vasco da Gama, with his brave crew, actually reached the southern tip of

Africa, sailed around it, and reached India by the all-water route!

The new route was hailed with joy, for it did away with the need for an overland caravan from India. Yet it was a long, long route, and the merchant vessels still took many months to make a single trip to India. So the search for a better route continued. The merchants of Europe must find faster means of procuring goods.

An Italian navigator by the name of Christopher Columbus was one of the seagoing men who were interested in finding a new route. His ideas about this route were different from those of other navigators. He believed that the earth was round, though almost everybody in his day believed it to be flat. Because of his belief, he insisted that a ship could sail due west from Europe and finally reach India, which lay to the east of Europe.

Because Columbus's idea was new, it was ridiculed by most of the merchants, and for a while no one would furnish him money for trying out his experiment. But finally Queen Isabella of Spain supplied him with money enough for three small ships and the crew to sail them. So westward Columbus sailed.

For three months the tiny vessels braved the mighty Atlantic, sailing westward, westward, and ever westward. The crew, frightened, wanted to turn back. But not Columbus. He sailed ever westward, until one day he finally reached land!

"India!" Columbus thought; "India!" thought his men.

But it was not India that Columbus had reached. It was an island near a big, new, wonderful continent — a continent of which neither Columbus nor the people of Europe knew.

Then Columbus and his sailors went back to Europe and told the people that he was right — that they had reached India by sailing west, and that they had seen the natives of this land wearing ornaments of gold.

Gold! It was a magic word. Soon other vessels from Europe set out to find this land. For the next few years many groups of sailors and adventurers made this same trip. They sailed for weeks and weeks, just as Columbus had done. Finally they saw land, went ashore, and looked about them — looked for the gold and for other precious things that they knew abounded in India.

In time, the searchers realized that the new land was not India. Yet what a land they found it to be! The people from Europe had never seen anything like it. It seemed to be covered with forests. Great, tall, beautiful trees beckoned to them from almost every foot of coastline. Rivers ran back into the forests, teasing men to follow and to find out where they led. Great lakes sparkled in the sunlight, inviting the explorers inward, inward, inward. And inward they went, seeking, seeking, seeking for gold and precious things.

A rich land it was, indeed, in many things besides gold. The people from Europe were delighted with what they had found. As each group of explorers returned to Europe, they told marvelous tales of the new continent — tales of the abundant forests, of plentiful wild life, of a wonderful climate, of thriving plants, and even of the gold. They called the new land *America*.

Then the people of Europe became excited. They sent out more exploring parties made up of brave men who were to sail up the rivers of America and find out where they led. They were to enter the deep forests and find out what they contained. They were to cross the mountains and see what strange things were on the other side. The people of Europe wanted the explorers to find out who lived in this new land and what manner of people they were. People of Europe were indeed curious about the new land.

What did the explorers find?

They found land — thousands of acres of it. They found enough land to supply a farm for every family in Europe that would undertake to move to the new country. They found so much land that they wondered how it could ever be put to use. They found land so rich that it seemed to them it might furnish food for the whole world of people.

The searchers found huge forests, too — forests large enough to provide lumber for houses and for ships and fuel for warmth. They found millions of

wild animals living in the forests. They felt certain that the pelts of beavers would furnish fur hats and coats for all the gentlemen of Europe for centuries to come.

They found seas and rivers and lakes full of fish. They found a climate suitable for raising food, yet vigorous and healthful. And they found groups of copper-colored people living in the forests, using the fish and wild animals for food, but leaving untouched almost all the resources of the continent.

But the early explorers did not find all the resources of the new land. They did not find the treasures hidden in the mountains. They did not find the buried metals. They did not find the coal and petroleum. What excitement there would have been if they had known also of all these riches!

RUMMAGING

To the people of Europe, finding America was like finding a vast new cupboard stocked with all sorts of provisions for them to use. They wanted to rummage through this new cupboard to see what it contained. And rummage through it they did!

They were excited over their new possessions. They were delighted with the new supply of natural resources which the continent contained. What vast supplies of land, of wood, of fish, of wild life!

But to whom did this storehouse of wealth belong? The French said it belonged to them. The Spanish said it belonged to them. The English said it was

theirs. The Dutch wanted it, and so did the Swedes. Nearly all of the countries of Europe wanted to have the right to rummage through this new cupboard. Each country thought it had a right to these things because each country had sent out groups of explorers.

And nearly all the time that the people were rummaging to find out more about the contents of the new cupboard, the countries were fighting and quarreling over its possession. It took centuries for the countries of Europe to settle the quarrel. Finally when they did get through quarreling about it, it was decided that the new continent belonged to none of them. It belonged to the people who had come over here to live. The new inhabitants came to be recognized as the real owners of the new supply of natural resources — not the governments under whom these people had once lived.

While the countries of Europe were quarreling about the riches of this new land, the settlers of the new land were making use of them. They cut down acres of forests. They killed the wild life of the woods. They caught fish. They plowed up the land. Even after the fighting over the possession of the continent had ceased, the settlers went on using the natural resources of the land as they saw fit to use them.

"We have more wood and fish and land than we can use in a million years," thought the settlers. "This new country is so rich that we can use its wealth freely and still have plenty."

Culver Service

THE CABIN OF A NEW ENGLAND SETTLER

This old print shows the typical log cabin of the early settler. It was built in a "clearing" in the forest, made by hewing down trees. In time, the settler cleared enough acres of land to provide fields for the raising of crops.

And so the early settlers in our country used all the natural resources they could. It was quite right for the people to use them. But they used them with no thought of the future. Many of the forests they cut down have never been replaced. Some species of wild life which they found in this country have been entirely killed off.

Finding a New Land. I. In a history or in an encyclopedia read all you can about Europe in the fifteenth century. Read especially about the merchants and the merchant fleets, and about the desire of the people of that time for the rich products of India.

II. Find stories of the gold seekers who came to this new land. Did any of them find gold? Did they find any Indian tribes in North and South America who possessed gold?

Turning Materials into Gold. In what ways did the real settlers of the United States prove to be better "gold seekers" than those earlier searching parties? Find out what some of the industries were that the early colonists developed, what natural resources were used in developing them, and what products the colonist sent back to the Old World in trade.

Killing the Goose. Recall the old fable of the man who killed the goose that laid the golden egg. Then find out what wild life — either fur-bearing animals or fowl — was entirely killed off by the earlier citizens of our country. Explain why we have game laws now.

IV. OUR FARMS AND OUR FORESTS

Most of the people who came from crowded European countries to live in America had dreams of owning acres of fertile farmland. Indeed, many of the people came only for the purpose of getting land. The dreams of many of them came true, for most of the early settlers of our country became farmers. Let us see where they settled and how they used the land.

CLEARING THE LAND

The white men who came to this new land as colonists three hundred years ago came to use the land. And what did they see on their arrival? Forests — forests everywhere along the Atlantic coast, dark and silent and gloomy. Only occasionally did they find openings in the dense forests where lightning had set fire to the trees or where the Indians had cleared a few acres for their little plots of corn and squash.

The forests made good hiding places for the Indians, as we know. Whether Indians were there or not, the settlers expected to see them whenever they entered the dark woods. Was there a stir behind a stump or a pile of underbrush? It must be Indians lying in wait, ready to spring upon them! Was

there a noise in the night? Indians must be creeping out of the deep forest to attack them. Always, in their imagination, the Indians were near — hiding, waiting for a chance to do them harm.

The forests sheltered wild beasts, too. So fathers and mothers suffered when their children were out of their sight. They suffered fear when they themselves had to travel through the woods. They suffered fear when the night came and they could no longer see what the forest might be hiding. The forests were dark and mysterious and fearsome places.

Then, too, the forests meant cruel work to the settlers — chopping down trees, clearing away underbrush, pulling up stumps. The settlers did not have tractors to hitch to the stumps to pull them out of the ground. They did not have dynamite with which to blow the long roots loose from the earth. Nor did they have strong chains or heavy draft horses to help them with this work. They had axes and saws. They had their own strong arms and their own strong backs. It was hard work to clear the forests.

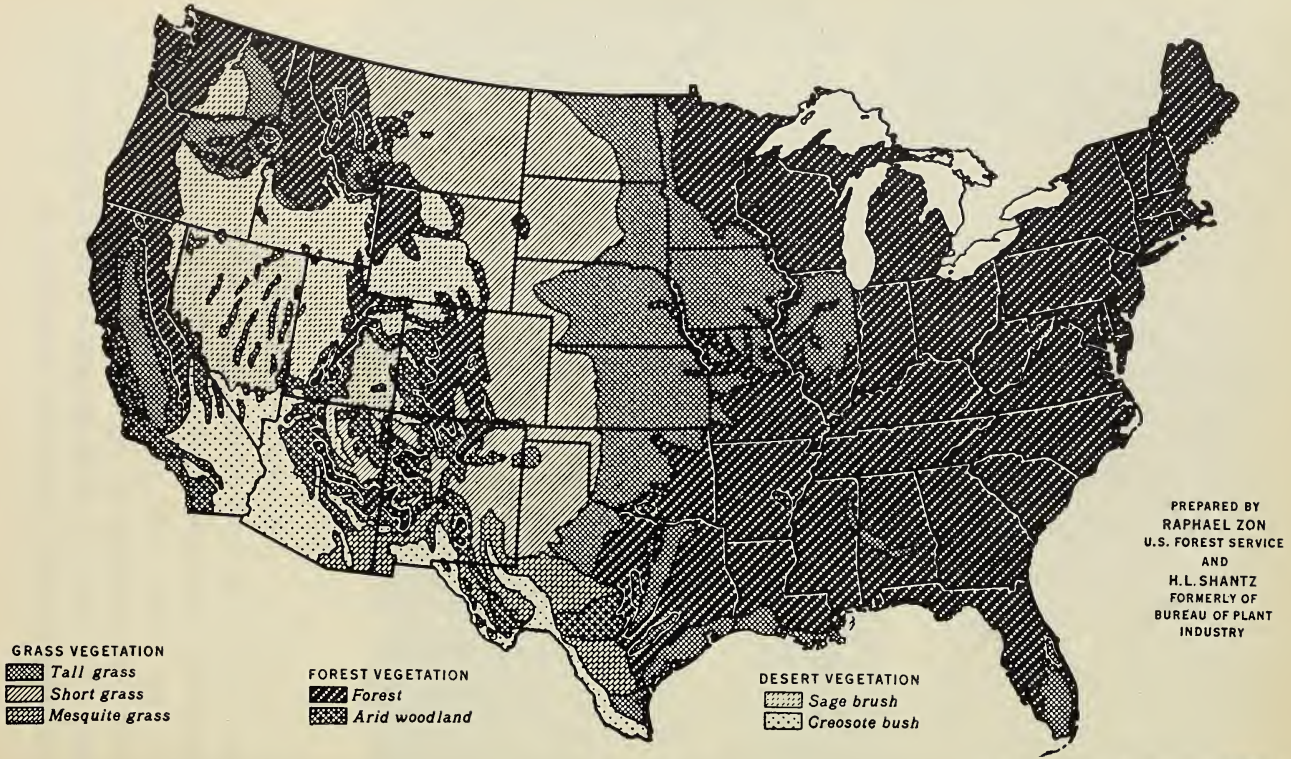
And so it is not surprising that the forest seemed to the early settlers to be something to get rid of, something to destroy. Forests kept them in fear. Forests kept them from using the land. Forests made hard work for them.

For the most part, the early settlers used the Indians' methods of clearing land. Sometimes they bruised the larger trees near the roots and then

Culver Service

LUMBERING IN EARLY DAYS

scotched them with fire, killing the trees, and later they felled the dead trunks with axes. Sometimes they chopped the smaller trees down and burned up the logs. The work of clearing the land was slow because it had to be done by hand. Neighbors helped one another, and together a community used the little cleared places in the woods.



Courtesy Bureau of Agriculture Economics

A MAP SHOWING THE VEGETATION AREAS OF THE UNITED STATES

The settlers used the timber which they cut down for many purposes. They built houses of it. They used it for fuel. They made furniture, tools, weapons, and kitchen utensils of it. No one had to buy timber. Everyone had all the wood he could use.

Thousands of acres of land were cleared in this way. Perhaps it seems strange to you that our thrifty ancestors would have been willing to waste so much of their timber. But what could they do about it? They had to have food to eat. To raise food, they had to have cleared land. They used the easiest and quickest method they knew for clearing the land.

The destruction of the forests began when the first boatload of colonists arrived in the new world. It continued all during the colonial period of our history. After the colonists had fought the Revolutionary War, which gained them their independence from England, bands of them began to move westward from the coast, hunting new farmlands. They cut and burned their way through the forests beyond the Allegheny Mountains and all the way to the Great Plains, where few trees grew. They crossed the Mississippi River and moved on over the plains until they reached the western grasslands, which have since become our prairie states. On westward they traveled, always making farms. Forest lands or grasslands were all the same to them — they felled trees and plowed up grasslands. Land meant soil. Soil meant crops. And crops meant food and

prosperity for them. Even within the memory of your grandparents, land has been cleared for farming by destroying the forests.

Clearing the Land. I. Find a good story to read aloud to the class, telling of the fear of Indians the early white settlers had. Discuss this problem. Do you think they needed to fear the Indians? What did some of the early settlers do to escape the dread of Indian attacks?

II. Find out exactly how the early people cleared the land. Make pictures showing them doing this work.

III. In what ways did the forests help the early settlers? List the uses which they made of the forests.

IV. Explain why the earliest settlers did not sell the timber they cut down in clearing the land for farms. Would there not have been sale for it in Europe?

THE USE AND ABUSE OF FORESTS

After the earliest settlers in our country had cleared forests, built crude homes, and planted crops, they came to realize that their trees had value. The settlers were becoming prosperous. They wanted more comforts. The timber could be used to build better homes. It could be used to provide more furniture. It could be used in fashioning new tools and in building vehicles of transportation. It was natural that the settlers should want these things after the first great task of clearing lands and planting crops had been done. So more trees were felled to provide new comforts and conveniences.

Culver Service

THE BUILDING OF THE *ONRUST*

This ship was built in the Dutch colony of New Amsterdam.

Among the colonists were good business men, too. They realized that a colony must have products to trade in England and France and other European countries in exchange for things that could be bought only across the waters. What products could the new land produce? The forests furnished the first answer to this question. Fine, tall trees were felled to be sent abroad as masts for sailing vessels. Before long, a lively shipbuilding industry grew up in the New England colonies, and the ships which were built here were sold to England. Shipbuilding required lumber of certain kinds; so more trees were felled. Shingles and prepared lumber were made by the colonial workers and sold in England.

Courtesy U. S. Forest Service

VIRGIN WHITE-PINE FOREST

The colonists also learned that other forest products besides lumber would provide articles of trade. Turpentine, pitch, resin, and tar were needed in England for naval supplies and for other purposes, and soon the people in the Southern colonies learned to produce these things from their forests. Often they were careless in extracting turpentine and pitch from the trees, injuring whole forests and leaving them to die. Why should they take time to handle the trees carefully? There were forests in great plenty, and it took less time to move on to a fresh forest than to exercise thought and care in draining the trees of their products.

In building up these three industries — lumbering, shipbuilding, and production of naval supplies

Resettlement Administration Service Photograph by Rothstein

CUTOVER FOREST, SHOWING EXPOSED SOIL

— the early settlers began to learn that their forests had value. That is, they no longer considered the forests as barriers which kept them from using the land, but grew to look upon them as a source of important products of trade. Men no longer burned wood as they cleared the land. They saved it and sold it. As soon as harvest was over, many farmers left their farms and went to the woods. All winter they chopped and sawed and hauled the logs to the mills. In the spring they returned to their farming.

Through the years in which these industries grew, millions of acres of trees were cut down — old trees, middle-aged trees, young trees. Lumbermen took only the best ones. They used only the parts of each tree which best suited their purposes. Tops

Courtesy U. S. Forest Service

THE RESULT OF RECKLESS LOGGING

of trees were sawed off and left to rot in the forest. Big limbs and little limbs were wasted. Only the trunks of trees were used. Turpentine was bled from the longleaf pine until, finally, the trees died.

In the early period of development of these industries, the work of getting out timber from the forests was slow. Much of it was done with hand tools, which were none too well made. The axes were cumbersome. The saws were thick and small. As time went on, the tools became better and stronger, and new types of tools were invented. Strange as it may seem, however, the work of cutting down trees is still a hand industry.

At first the work of getting out timber was done with the help of oxen. Later horses were used —

Courtesy U. S. Forest Service

CAREFUL LOGGING

huge draft horses, large and powerful. But even with these the work moved slowly. In time, large commercial companies built railroads into the forests and used locomotives and flat cars for hauling out the timber. Today, huge trestles on which move endless belts carry the logs to the mills to be cut into lumber or to the railroads to be shipped to the mills.

The first power sawmills were built around 1630. They were run by water power, the power operating a vertical saw which could cut only small timber. Such a mill cut about one thousand board feet of lumber a day, or about sixty-five boards. For over a century this type of mill was the only type used in our country. Then, in 1767, a mill using a gang saw was built. The gang saw could cut five times as

many boards a day. Still later the circular saw came into use. A circular saw was able to cut 40,000 board feet a day — forty times as much lumber as was cut by the earlier vertical saw. Then steam was introduced into the sawmill business; and by the use of steam power 125,000 board feet could be cut in one mill in one day. Finally the band saw was invented. A band saw run by steam could cut timber at the rate of 1,000,000 board feet a day.

The improvements in the machinery and in the methods used in lumbering helped to make even greater inroads upon our forest resources. Acres of trees were cut over by lumbermen who took only the best and left the rest to be wasted.

And so you see that our forest resources have been cut down by two groups of people — the farmers who wished to get rid of the trees so that they might use the land for farming; and the lumbermen who wished to use the timber for commercial purposes. Both of these groups were doing necessary work. Both helped make our people more prosperous, more comfortable. But both were wasteful in their use of one of the finest of our natural resources. The early farmers burned the timber, wore out the soil by planting the same crop year after year, and when the land had lost its fertility, moved on to fresh land where they cut down more forests. The lumbermen hewed through the forests, took only the forest products that they needed, and did not stop to replace the trees they took or destroyed.

The industries that have ravaged our forests added to the fire menace in our forests. The dead branches left by lumbermen lay on the floors of the forests like so much kindling, waiting for a spark to set them off. When the spark was supplied by some careless hand, by lightning, or by a passing locomotive, the forest became a huge bonfire. In many cases of serious forest fire the evil started long before the spark was supplied. It started with the people who failed to clear the forest floors of dangerous tinder. Forest fires have been one of the chief means of wasting our forests.

Destructive fires still continue to ravage our remaining forest areas. Out of every hundred forest fires today ninety are caused by carelessness. About fifty thousand fires occur yearly in our country.

A forest is a crop — a crop that grows slowly. But all the trees in a forest of trees are not ready for harvest at one time. In most forests are to be found old, full-grown trees, ready for cutting; young trees which are just reaching their prime and which should be left to bear seed for future trees; and baby trees which need protection. Forests may be thinned out each year by cutting down the old trees. The young trees will then be given a better chance to grow large and well formed, and the baby trees will be given a chance to get the sunlight and air which they need. The earlier farmers and lumbermen did not take time to think this out. They just cut down whole forests.

Courtesy U. S. Forest Service

FIRE PATROL OF THE UNITED STATES FOREST SERVICE

If we want to preserve forests, they must be replanted. The trees themselves take care of some of the necessary replanting, dropping seeds each year on the floor of the forest. But often the replanting should not be left to nature. Experienced foresters should plant baby trees where the full-grown trees have been cut down. Forestry departments in many of our states are now raising young trees from seed so that they may be able to replace trees that are cut from our forests.

The citizens of our country, our state government, and our national government have now come to realize the value of our forest wealth. Citizens are learning to protect trees and forests. Our state and national governments have special departments whose work it is to protect our forests from ravaging fires and from diseases and insect pests, and to study ways of preserving them.

The destroyers of our forests did more than decrease our supply of lumber. They did not realize that they were also helping to destroy our farmland. We who are living today know that forests have helped to preserve our fertile farms by storing up water in the soil, by controlling floods that wash away our rich topsoil, and by preserving the wild life of the country. Had our ancestors known these things, they probably would have saved large belts of forests in every section of our country.

Using the Timber. I. Talk to a worker who uses wood and find out the kinds of wood used for making furniture;

for the outside of houses; for the interior finish in houses; for making boxes and crates; for making golf clubs; for making airplane propellers.

II. Find out about one of the forest products: (1) how the work of producing it is carried on; (2) the kinds of tools and machines used; (3) the workmen themselves. You might choose one of these products: maple sugar, turpentine, rayon, tanbark, paper, lumber, potash, pitch, tar.

III. Find out about our present-day use of trees in the making of paper.

Forest Preservation. I. Find out where forests are located in your state. Then find out whether you have a Department of Forestry in your state government; if you have, find out what work it does. Perhaps your teacher will help you to find material about the work of your State Department of Forestry.

II. Find out all about the work of our United States Department of Forestry.

III. Write to the National Park Service of the United States Department of the Interior for pamphlets and pictures which will tell you all about our national parks and national forests.

THE DESTRUCTION OF THE GRASSLANDS

When the pioneers began moving westward across the Appalachian Mountains, the attractiveness of the broad and fertile lands they found there started a regular movement of farmers to the West. The whole section which has since become Kentucky,

Tennessee, Ohio, Indiana, Michigan, and Illinois was soon cleared of forests or of grass and turned into farms. The stream of pioneers continued, and soon they had crossed the Mississippi River and reached the Great Plains — the land sometimes called the "land of the tall grass." Some of this grass was so tall that men walking through it could not be seen. Before many years farmers were scattered all over that section of the country, too.

What a satisfaction it was to these pioneer farmers who traveled west far enough to find grasslands in place of forests! Nothing to clear away but the tough grasses with their tangled roots! Their plows cut into the fertile soil, and soon they planted their grain. In a few months tall cornstalks were waving in the breeze in place of the high grass which had been there so long, and which had seemed useless to the pioneers. Barley, wheat, and rye were planted over the northern half of the land. Big, prosperous farms were everywhere.

Westward and farther westward moved the farmers. Some were immigrants who had just come from Europe and who could not find free land in the East. Some were farmers from the older settlements who were finding their farms no longer fertile, because they had worn out the soil by planting the same crop year after year. Some were adventurers who went westward just because they liked new country which had not become settled and enjoyed the thrill of helping to settle it.

Ewing Galloway

A CATTLE RANGE IN THE GRASS COUNTRY

On the rainfall map that is given on page 283, find the one-hundredth meridian. This meridian passes through the middle of North Dakota and on down through Texas. West of this one-hundredth meridian there is not enough rainfall in most parts of this section of the country to produce good crops.

For a number of years the searchers for farmland halted at this line. A few went west into the drier territory and tried to farm, but they soon became discouraged. Yet the land west of the hundredth meridian was good grazing land. The cattlemen came to look on this great expanse of grass as their paradise. In time, millions of dollars had been invested in cattle. Englishmen and Scotchmen, as well as citizens of the United States, invested their money to set up cattle ranches and raise cattle.

Ewing Galloway

A SHEEP RANGE IN THE GRASS COUNTRY

One company operating ranches in Colorado, New Mexico, and Texas had 150,000 head of cattle grazing on the grass of the plains. The cattlemen did not own the land. They had only leased grazing rights on this land.

For a number of years the cattlemen pastured their herds on the short grass growing on the plains of Kansas, Nebraska, the Dakotas, Oklahoma, Texas, Arizona, and New Mexico. Cowboys tended the cattle. The stock was sold on the hoof to large meat companies in Kansas City, St. Louis, and Chicago, who supplied meat to all parts of the United States.

And then came the sheepherders. They wanted pasture lands, too. But the cattlemen did not want to share the pastures with them. Cattle will not graze near sheep, for they dislike the odor of sheep.

Then, too, the sheep cut the sod with their little sharp hoofs and ruin the grass. The sharp teeth of sheep nibble the grass so close that they injure the roots of the plants. Grass does not grow well where many sheep feed.

The cattlemen fought the sheepmen for years, but finally they had to give up the battle. For a while both sheep and cattle used the ranges of these western lands. Finally, however, the grass began to fail. The land was "overgrazed," as the cattlemen say, by the millions of animals feeding upon it. Their hoofs cut the sod and let the moisture escape. After a few years the pastures, which at one time had been so vast that men thought they could never use all the grass, were no longer large enough for the herds that fed upon them. Both sheep and cattle suffered.

In the meantime, railroad lines had been built throughout parts of these western lands. They had been built at an enormous expense, and it took a great deal of money to operate them. These expenses could be met only if the railroads had plenty of freight to haul over long distances. They wanted grain to transport to eastern markets, so that their business would thrive.

The railroads began advertising a new kind of farming. They told of the wonderful fertility of the land in these western states where there is little rainfall. "Frequent rains are not needed in this new kind of farming," they told the farmers. "What

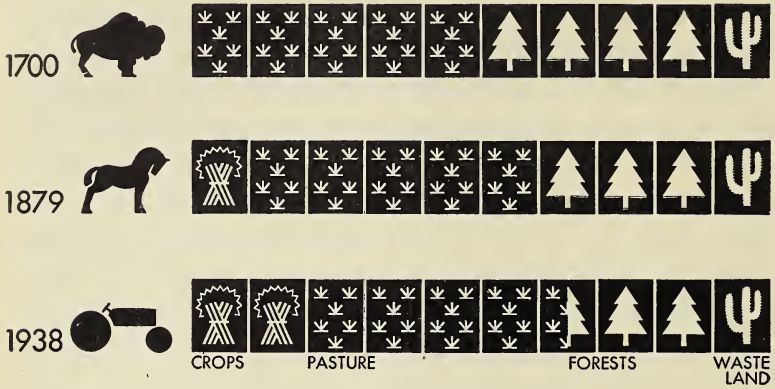
we need to do is to save the moisture we already have in the ground."

What was this new kind of farming? It was called *dry farming*. The success of dry farming depends upon four things. First, the land must be plowed before the rain falls. Second, the soil must be cultivated often, so that the moisture will not escape through evaporation. Third, crops must be carefully selected; only crops which do not need great amounts of moisture should be chosen. Fourth, crops should not be planted every year, although the land must be cultivated often to keep the moisture in. Dry farming pays only on large farms, for power machinery is required to do the great amount of cultivation needed. Men with small farms cannot afford tractors, five-bottom plows, and combines.

About this time the government passed the Homestead Act. This act allowed a farmer to claim one hundred sixty acres of western land if he would go out, live on the land, and cultivate it. Many farmers left their farms in other parts of the country and went out to the Dakotas, Nebraska, Kansas, Oklahoma, and Texas to set up their claims. They selected seed which did not need much moisture to grow well. They bought power machinery. And they plowed up more grassland — acres and acres of it.

Finally, in 1914, the World War started in Europe. The people of Europe were so busy fighting that they did not have time to raise food. The people

LAND USE IN THE UNITED STATES*



EACH SYMBOL REPRESENTS 200 MILLION ACRES

Can you read this pictogram? It tells the vegetation story for three periods in our history. Which symbol means grassland? Forest? Desert? Cultivated fields? Study the story of each period. Then tell what it means.

of Europe needed food. Wheat, corn, sugar, and meat were needed. Prices began to go up. The people of Europe needed all the food that American farmers could raise. The farmers plowed up more grassland and sowed the land to wheat, to potatoes, to all kinds of crops. The railroads carried the grain to the Atlantic seaports. Huge ships took it across the ocean to the warring nations.

In 1918 the World War ended. The farmers of Europe began to raise crops again. They no longer needed American grain. Farmers in the United States, however, planted as much grain as they had during the years of the war. What happened?

* Adapted from a chart in the Mississippi Valley Committee Report by Pictorial Statistics, Inc.

They could not find a market for their grain. Many of them could not pay the taxes on their land. Many of them could not make the payments on their land, on their buildings, on their farm machinery. They borrowed money to make these payments, giving their land as security. Then many of them could not pay back the money when it was due, and they lost their land to those from whom they had borrowed.

Settling the West. I. The grasslands of the West were used as pastures long before the coming of the white people. What animals grazed upon the Great Plains in those days? What became of these animals?

II. Read in a history of the United States about the westward movement of people. Find out how they traveled west and how they took possession of the land.

III. Read about the development of the cattle and sheep industries in the western states.

IV. Read in your geography about *dry farming*. Find out how dry farming is done, where it is carried on, and why dry farmers have very large farms.

V. Find out what became of the Plains Indians when the grasslands were settled.

Finding First-Hand Information. Send to the Agricultural Department in Washington, D. C., for bulletins telling about the destruction of the forests and the grasslands of the United States. Ask for bulletins on conservation of natural resources. Read these bulletins and study the pictures, for they will give you much information.

OUR GREAT SOIL PROBLEMS

You have been reading about some great changes which have taken place in our country in the last three hundred years. You have learned how our people destroyed many of their forests. You have found out how the grasslands were first turned into pastures for sheep and cattle and then into farms for raising grain. Our people made these great changes to satisfy their desire for land. Probably they thought it was necessary to have many huge farms. No doubt they thought that they were doing the right thing in turning forest and pasture land into farms. But were they? Have all the results been good? Have the changes improved the value of the land, or have they destroyed some of its value?

In the years before these changes, trees and grass made a tough, durable covering for the soil. Held by the tiny rootlets of the grass or by the huge underground network of tree roots, the soil had been kept in place for ages of time. Rains fell, but they did not loosen it. Floods raged through the valleys, but they did not wash away the soil. Winds blew year in and year out, but they did not scatter the soil particles. The covering of grass and trees was able to protect the soil — man's most valuable natural resource.

But now much of our soil has been deprived of its protective covering. It lies exposed to the action of two powerful forces, wind and water. We call

the action of wind and water erosion. Erosion is the wearing down of rock or land surface. It was erosion of the rocks that gave us our soil in the beginning. Now, erosion is carrying away the soil which it gave us.

Soil is of two kinds — topsoil and subsoil. The topsoil is the fertile soil in which plants grow. It contains the humus or decayed plant and animal matter. It contains the mineral substances necessary to their growth. Subsoil is not fertile. It forms a base for the topsoil. The loss of topsoil means the loss of fertility. Unfortunately it is the topsoil that is carried away by wind or water erosion.

Soil erosion may be a slow, unseen process; or, it may be a rapid process which can be seen as it goes on. Often farmers do not know that erosion is taking place on the land until the subsoil is all that is left of their once fertile fields. They see the muddy water draining from their fields. But they do not seem to realize that the mud particles are some of their precious topsoil. They see the dust whipped from the ground with every gust of wind. But they do not seem to know that those clouds of dust are made up of particles of fertile topsoil. When land is without a covering of some kind of vegetation, wind and water will soon rob it of its topsoil.

There is a great difference in the action of water on grass-covered surfaces and on those surfaces which lie bare. Grass roots make the soil porous. Tiny holes made by the grass roots and by worms

Courtesy U. S. Forest Service

EROSION OF A SLOPING FIELD

burrowing in the soil allow water to trickle down into the ground. The grass acts as a sieve, letting the water seep into the earth. On grass-covered surfaces the water sinks into the ground and filters far down below the surface. Finally it reaches the *water table* — a series of underground pools — where it is stored. Gradually, as this water is needed, it is taken up again by the roots of plants, or it is pumped up for the use of man. A plentiful supply of underground water is necessary in order to make soil productive.

When rain falls on unprotected soil, the water acts differently. The first sprinkling of water on the particles of soil lying right on the surface forms them into a pasty mud. Soon there is a layer of

Courtesy U. S. Forest Service

DEEPLY GULLIED FARMLAND

mud about an inch or two thick spread over the surface of the topsoil. This layer of mud keeps the rain from getting down deeper into the earth. Instead of a sieve of roots filtering the water down into the earth, there is a top surface like plaster keeping the rain from sinking down into the earth. Now, the rain that continues to fall has to go some place. Instead of sinking into the earth, it flows off the surface, carrying with it particles of rich topsoil. As it flows, it furrows out tiny ditches. If it rains long enough, these ditches become gullies, and the water flowing through these gullies carries off more and more topsoil.

The first result, then, of unprotected soil is the loss of topsoil. But the second result is also serious.

Philip D. Gendreau

GULLYING STOPPED BY DAMS AND PLANTING

Since very little water sinks into the earth, there is not enough underground water to supply the roots of trees and plants in the next dry season. The water has all flowed off the surface of the earth — from furrows into gullies, from gullies into ditches, from ditches into brooks, from brooks into lakes or rivers. The rivers and lakes become swollen, and perhaps overflow. But very likely the soil in the fields will be too dry, before long, to produce crops, for the underground pools have been robbed of their share of water.

During the dry seasons, if crops fail, the soil is exposed to wind erosion. In the United States winds blow fairly steadily from the west. These steady winds lift soil particles from uncovered dry fields and send them in clouds across the country.

Keystone View Company from U. S. Forest Service

PLANTING ON A SLOPE TO PREVENT GULLYING

During the past few years, *dust storms* have been frequent in the western half of our country. The clouds of dust — some of our finest topsoil — blow miles across the country, drifting over other fields as snow will drift. In some places it chokes young crops entirely. It soils the water of wells and springs. It irritates the eyes and chokes the throats of cattle and human beings. Sometimes clouds of dust — topsoil from our western fields — have blown as far east as our Atlantic coast. One part of our country has become so greatly afflicted with dust storms that it is now called the *dust bowl.* Wind erosion is indeed a serious menace to our western farms.

Farmers are beginning to realize the menace of erosion. They are trying new methods of holding

the soil. Seeing that soil is naturally protected by plant growth, farmers are learning to plant *cover crops*. As soon as a grain crop is harvested, they plant a grass of some kind to protect the soil from the erosion of wind and water during the months when the fields must be idle.

Realizing that it is a law of nature that water will flow downhill, farmers are learning to plow their fields in a way that will prevent the flow. When a field lies on a slope, the farmers have learned that the furrows must be plowed *across* the slope of land, not with it. Furrows running down a hill will act as gulleys and help the water to flow away fast. Furrows running across the slope will hold the water where it falls until it has all sunk into the earth. Plowing across a slope or around a hill is called *contour plowing*. Plowing the wrong way — up and down the slope — is called *vertical plowing*.

The loss of the topsoil is not the only trouble caused by erosion. During the winter season snow falls in the northern states but does not melt. It does not sink into the frozen ground either. In the spring, as the snow melts, again a film of mud covers much of the unplanted land surface, keeping the water from sinking into the ground. The deep gullies covering much of the land carry the water into the rivers. The rivers rise higher and higher, finally overflowing their banks. Besides destroying homes and cities, and even human lives, the raging floods carry away still more topsoil from our fields.

Resettlement Administration Photograph by Rothstein

A COVER CROP OF HOLLAND GRASS

Keystone View Company

A SLOPING FIELD TERRACED BY CONTOUR PLOWING

U. S. Department of Agriculture, Soil Conservation Service

RUIN CAUSED BY DUST STORMS

Every spring our newspapers are full of news about the floods in different parts of our country. Every year millions of dollars' worth of damage is done by water which runs uncontrolled through the river valleys, destroying life and property.

Millions of dollars have been spent in trying to control the waters of these rivers. Their channels have been dredged to remove the silt which comes from the waste of the topsoil through erosion. The banks have been made higher with levees. Jetties have been built to protect cities. But still the rivers overflow. The remedy lies not in stemming the rivers. We shall have to begin at the beginning of the whole evil. We shall have to find some way of bringing our broad acres back to the condition in

Ewing Galloway

WATER OUT OF CONTROL

which they were protected from erosion by natural coverings. We shall have to find some way of letting falling rain and melting snow do the good that they were intended to do.

Some people have tried to estimate the tons of topsoil that have blown through the air in the past few years. We know that it must be hundreds of thousands of tons. It is estimated that four hundred billion tons of topsoil flow yearly from the fields of the Mississippi Valley, through the Mississippi River, and into the Gulf of Mexico. We also know that many of our fields are so gullied and furrowed as to be unfit for planting. We know that hundreds of farms have lost their fertility either through a loss of topsoil or because the soil has lost its richness due to

unwise planting. We know that hundreds of farmers in our country are suffering today from want because of the evils described in this story.

How shall we fight these evils? How can we reclaim the millions of acres of land already destroyed? How can we prevent two billion acres of land from becoming unproductive? These are problems that must be studied.

Protective Vegetation. I. Examine a piece of sod. Notice the matted roots of grass. Do you see how plowing up the grasslands can alter the flow of water?

II. Find a picture showing the root system of a tree. Study this to see how the destruction of the forests has changed the flow of water.

Erosion. I. Find examples of erosion of exposed soil on, or near, your school. Find what caused this erosion.

II. Find a way to show that moving water has force.

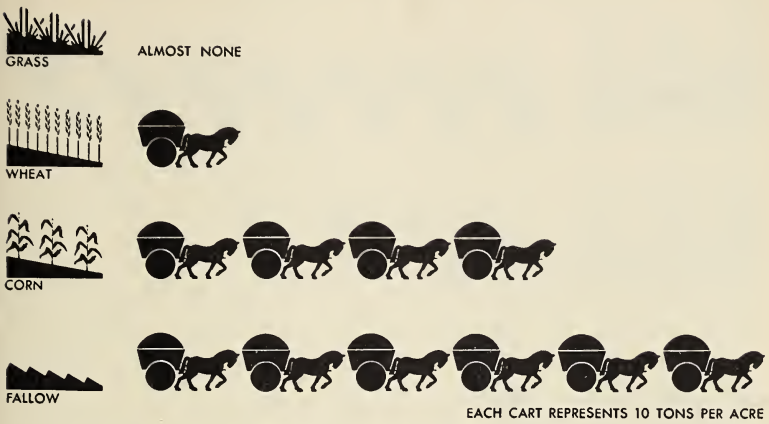
III. Discuss floods and the damage they do. Give examples of kinds of damage done by floods.

IV. Find out all you can about the *dust bowl.*

SAVING OUR SOIL

The people of the United States are becoming worried over the loss of their greatest natural resource — the soil. Many of them want to do something about it. They want to save the soil which is still good. They want to restore fertility to land from which the topsoil has disappeared.

SOIL LOSSES THROUGH CULTIVATION*

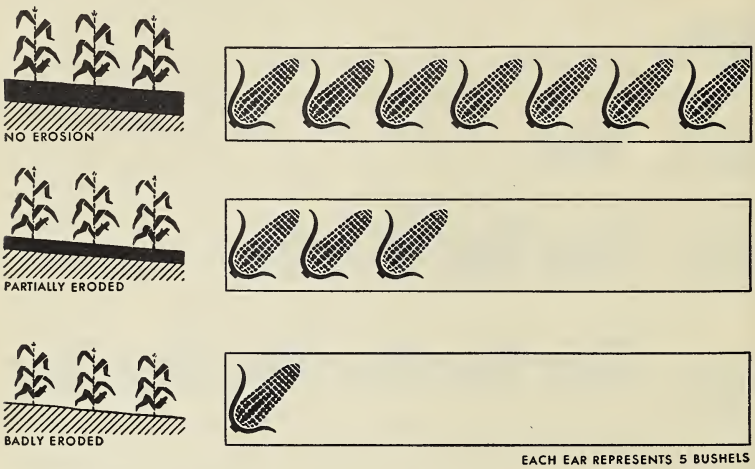


This pictogram tells about soil loss. Read the title above. Notice the little carts and read in the legend below the pictogram what each cart stands for. Then look at the pictures at the left and answer these questions: When soil is covered with grass, how much topsoil is lost? When sowed to wheat, how much is lost? To corn? When soil lies fallow, or uncovered, how much is lost?

Universities, experiment stations, state governments, and the federal government are helping to solve this problem. They are trying to find better ways of caring for water storage; of preventing water runoff; of rebuilding gullied land; of restoring fertility to soil that has been exhausted. They are replanting the forests and the grasslands.

One of these groups has undertaken the task of measuring the soil and water loss from erosion. Its workers have measured soil and water loss on land that had the same slope and the same amount of

* Prepared by Pictorial Statistics, Inc., for the U. S. Soil Conservation Service.



This pictogram tells how much a crop may decrease as topsoil is eroded. Use the title and Keys to tell the story.

rainfall but was planted to different crops or left uncovered. What have they found? They have found that one piece of land, plowed but unplanted, lost 105 tons of topsoil in one year's time. They found that a similar piece of land, planted to corn in summer, but lying exposed during the winter, lost 67 tons of soil a year. But land sowed to grass or alfalfa lost less than a quarter of a ton of soil in a year's time. What did they find out about the water loss? They found that grassland stored up the water, too, while unplanted land lost the water in much the same proportion that it lost soil.

One university has attempted to find out how much erosion is costing the farmer. These experimenters found that a piece of forested land lost

*Prepared by Pictorial Statistics, Inc., for the U. S. Soil Conservation Service.

only 115 pounds of soil in one year. A piece of uncovered or *fallow* land of the same area lost 112,316 pounds of soil in the same period. The soil from each of these pieces of land was analyzed to find out how much plant food was wasted. It was found that on the forest land the plant food could be restored at a cost of five cents an acre by using fertilizers. But the cost of restoring the plant food to the uncovered land was $59.15 an acre.

Some of the interesting work in soil conservation is being done by the Civilian Conservation Corps organized by the government. A few years ago thousands of young men in the United States were without work. Their families could not support them, for often the fathers did not have work either. Was there no work for the boys to do?

"Why not have these young men undertake the task of conserving the soil?" someone suggested.

The suggestion seemed a good one. Congress approved the plan. Within a short time 25,000 young men were enrolled in the Civilian Conservation Corps. *CCC Camps*, as they are called, were established in various parts of our country. In two years 500,000 men were at work.

Experts in land conservation and forestry taught the men methods for restoring, conserving, and replanting. The camp leaders made agreements with the farmers in a given area. Then CCC men went out to instruct the farmers as to the crops to be planted. They taught the farmers contour plowing.

They taught them also to sow their crops in strips only, leaving grass lanes between to hold the soil in place. They helped the farmers build dams to prevent gullies from further erosion. They taught them to rotate their crops and fertilize the land.

In some parts of the country the Civilian Conservation Corps undertook the problem of reforestation. Some land which had been cleared for farms had been found useless for crops. The CCC boys have planted millions of trees on these abandoned farms. They have done other things, too. They have learned how to fight tree diseases and insect pests. They have gone through our forests, sawing off broken limbs and painting the scars so that they will not decay and so that the sap will not escape. They have sprayed the trees to destroy the pests. Some of these young men have learned how to fight forest fires. They have built lookouts for the forest rangers. They have built miles of telephone lines into the forests so that help can be called when it is needed. They have opened up thousands of miles of firebreaks. They have removed fire hazards on millions of acres of land.

Reading about Farms and Forests. You may enjoy reading some of the stories in these books:

Our Plant Friends and Foes by William A. Du Puy

Field, Forest, and Farm by Jean Henri Fabre

Our Trees and How They Serve Us by Rufus S. Maddox and Almon E. Parkins

V. TREASURES IN THE EARTH'S CRUST

The metals and fuels of our land are of more value today than they have ever been. They are the foundation of our whole system of industry. Metals are necessary for the making of machines. Fuels and oils furnish the power to run machines. How are we using our stores of these resources?

COAL

In the world of industry which grew up after James Watt's invention of the steam engine in 1783, coal became king. Men had a new and greatly increased need for coal. It was needed for the furnaces which turned iron ore into steel. It was needed as fuel to furnish steam for the steam engines which turned the wheels in the new factories. Much of the work of the world came to depend upon coal.

Coal mines were opened up in all parts of the world — in England, which had rich coal beds, in Germany, and in France. Old mines were dug deeper. New mines were sunk. In a few years large areas which had once been peaceful farms and villages were turned into mining centers. The period of time during which the factory system developed is called the Industrial Revolution.

COAL FIELDS OF THE UNITED STATES

ANTHRACITE
Each car represents 25 million tons output, 1936
● Represents less than 2 million tons
PICTORIAL STATISTICS, INC.

Read the title above this map. Read the legend below at the left. The tall building that marks each coal field is a coal breaker. Find the little coal cars that tell how much coal each field produces, and the dots marking the less-productive fields. Compare this map with one showing the state divisions. In which state do the largest fields lie? Find the anthracite field. Find out what anthracite coal is.

When the Industrial Revolution spread to the United States, people had begun to move into the vast lands west of the Allegheny Mountains. As factories and railroads were built, they began to demand much coal. Many coal fields were opened up in these new lands.

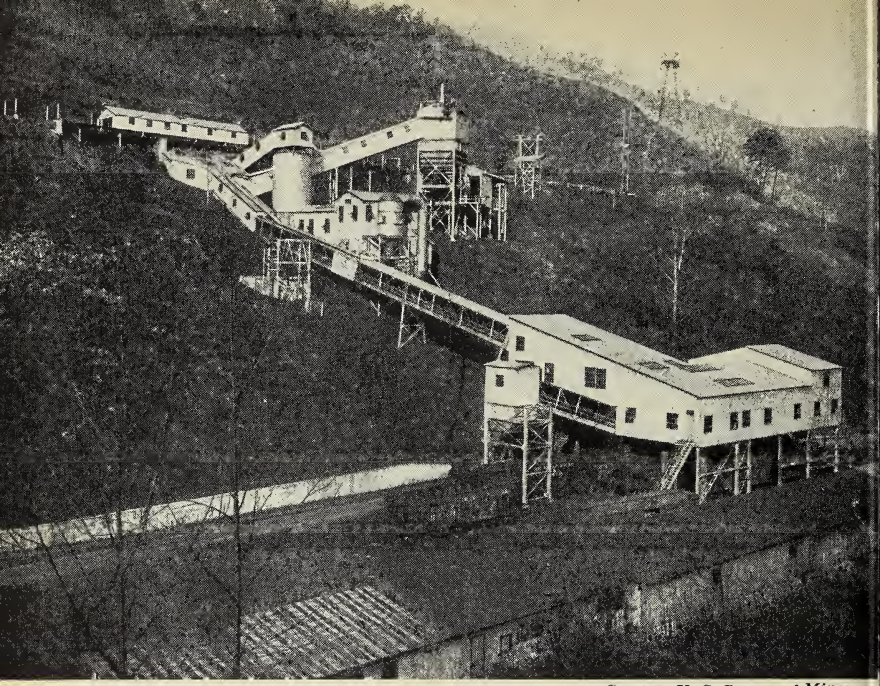
The early miners and mineowners did not realize that our rich coal supply should be handled with care. They did what it was quite natural to do:

they mined only those veins of coal which lay nearest the surface of the earth. They had little machinery and only a few tools with which to work; so they took from a mine only that coal which could be secured easily and cheaply. Then they abandoned the mine and opened up a new one.

Today our country furnishes over one third of the coal mined in the whole world. When you remember that the United States has about six per cent of the people in the whole world and about five per cent of the land area in the whole world, you will understand how wonderful it is that we are producing almost as much coal as all the rest of the world put together. You will understand, too, what an important possession our coal mines are. In our list of natural resources our coal stands next to soil as a source of wealth.

Even in more recent years wasteful methods of mining have often been used. During the World War our country was called upon to furnish coal to other countries. In order to get coal quickly and cheaply, many mining companies did just what the earlier miners had done. They mined the rich upper veins of coal and then abandoned the mine.

When a mine is abandoned, the pits usually become flooded with water. The pillars which support the ceilings of the pits decay, and the ceilings cave in. A mine that is caved in and flooded is difficult to reopen. The result is that the stores of coal lying in the lower veins of the abandoned mines may perhaps



Courtesy U. S. Bureau of Mines

THE SURFACE PLANT OF A COAL MINE

be lost to future use. If the mines are ever reopened, it will require more money and more careful methods of work to get the coal from these deeper veins.

Some experts believe that in the future great power plants will be built beside the coal mines. Coal can then be taken right from the mines to the power plants. The power plants will send heat and power by means of wires or pipe lines to the homes and factories of the surrounding country. Much of the cost and trouble of handling coal will be saved.

One means of saving our coal will come through greater development of our water power. A plant which produces electric power by means of water power is called a hydroelectric plant. Such plants

Courtesy U. S. Bureau of Mines

DRILLING A COAL VEIN IN THE MINE

have been built near some of our natural waterfalls or near rivers where great dams have been built. The water stored up by these dams supplies power for hydroelectric plants. Hydroelectric power is becoming a substitute, in many of our factories and industrial plants, for power secured from burning coal.

We waste our coal in our use of it, too. We have not yet learned to burn coal in such an economical way that every ounce of energy in the coal is turned into heat or into power. Some experts say that the average furnace in our homes wastes enough heat to heat a second house. They say that often the coal that is used to run one steam engine might be used to run another steam engine of the same size. Our

experts are at work on this problem. They are trying to produce better engines — engines requiring little coal. In some cities there are central-heating plants that supply heat to fifty or more houses and save the loss that comes from using fifty or more different furnaces. Perhaps some day a single heating plant will supply heat to a whole town.

The use of oil and natural gas for heating purposes is helping to save coal. But as our petroleum supply is also being exhausted rapidly, we may have to fall back on coal before many years.

With all our wastefulness, it is believed that our coal deposits will last some thousands of years. But have we not a problem before us? Do we not wish to plan carefully to develop better methods of using our splendid store of coal? Do the mines belong to us, to use up or destroy, or is it our duty to handle them in such a way that future generations may have their share of this valuable treasure?

Importance of Coal. I. On an outline map of the United States show our coal fields. How much coal does the United States mine yearly? Is any of this coal shipped to other countries? What other countries produce a great deal of coal?

II. Nations sometimes fight over the possession of coal deposits. Why? Can you explain their great value?

III. Why do people often warn us to save our coal — a product of the ancient forests — but say little about saving our living forests?

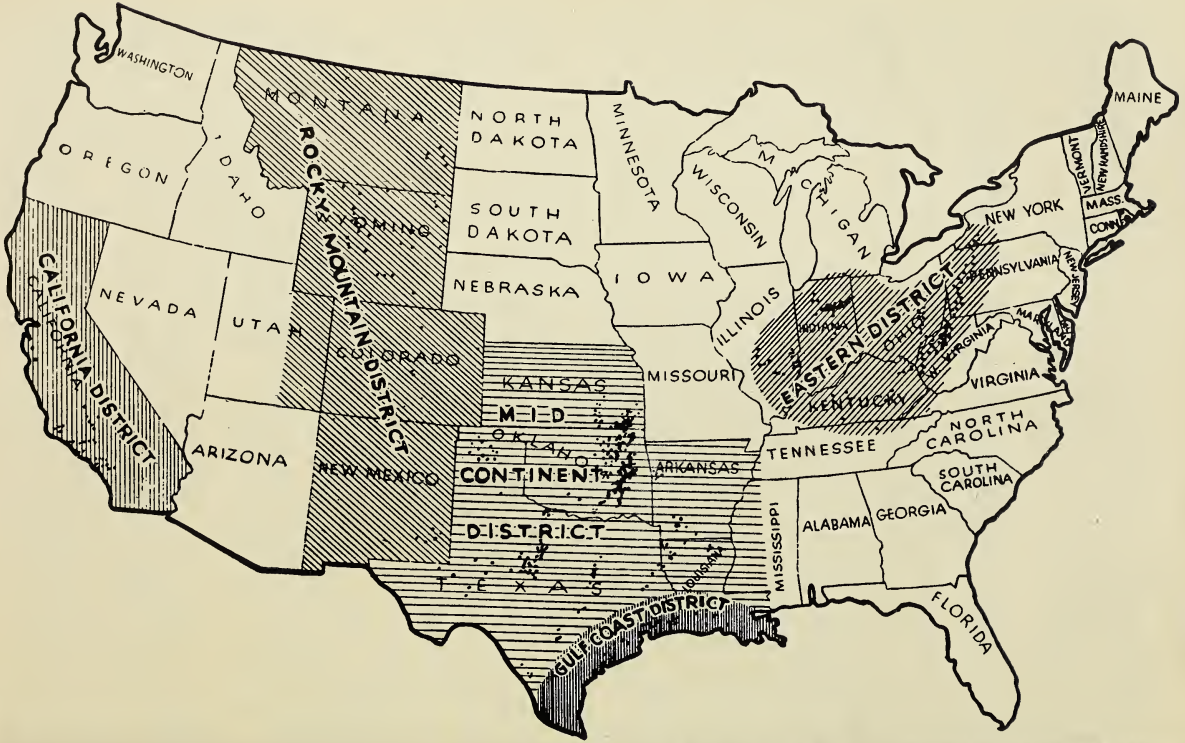
Other Fuels. Coal is used: (1) for heating purposes, (2) to supply power. What other fuel is being used today for the same purposes?

THE CONSERVATION OF PETROLEUM

It is estimated that the oil pools lying beneath the surface of the earth in our country contain about one fifth of the world's supply of petroleum. Today this country is supplying more than seventy per cent of the petroleum used in the world. Besides, much petroleum is being wasted in the process of working our oil wells. What will happen if this state of affairs continues? Will the United States exhaust her oil supply before the supply in other parts of the world is exhausted?

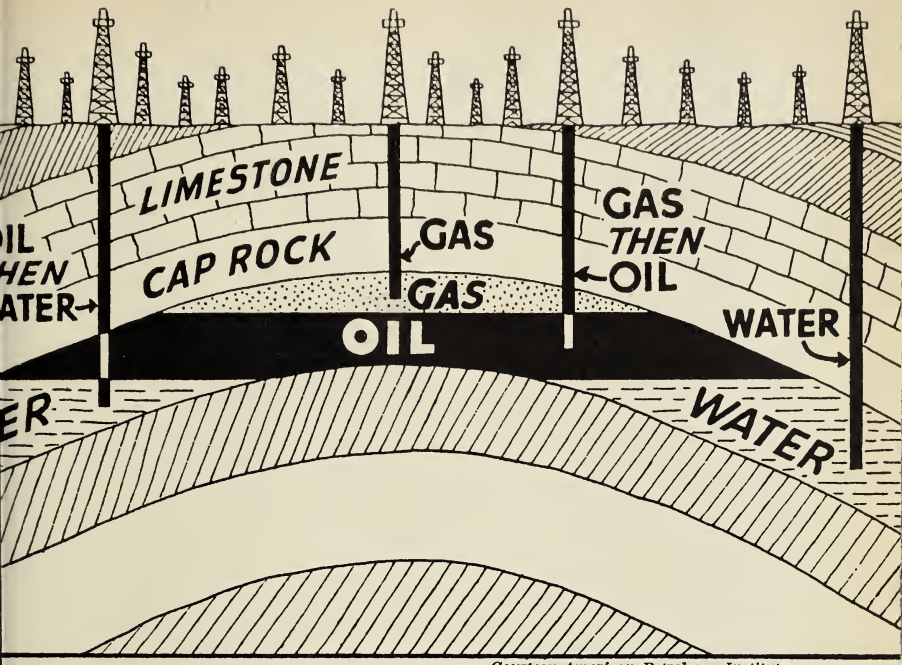
An area of land under which an oil pool lies is known as an *oil field*. The map on page 374 shows where the important oil fields in our country lie. As you see, there are hundreds of oil pools scattered through many states. Some of them are old pools which have been yielding oil for years. Some of them are new pools which were tapped just recently. There are some pools which have not yet been tapped.

In our country a person who owns a piece of land has the right to any mineral or oil beneath the land. An oil field is usually owned by a number of people who may have bought the land without knowing that there was an oil pool beneath the soil. Each owner may fence off his land, but he has no way of separating an oil pool that might be beneath the land.



Courtesy American Petroleum Institute

THE OIL FIELDS OF OUR COUNTRY

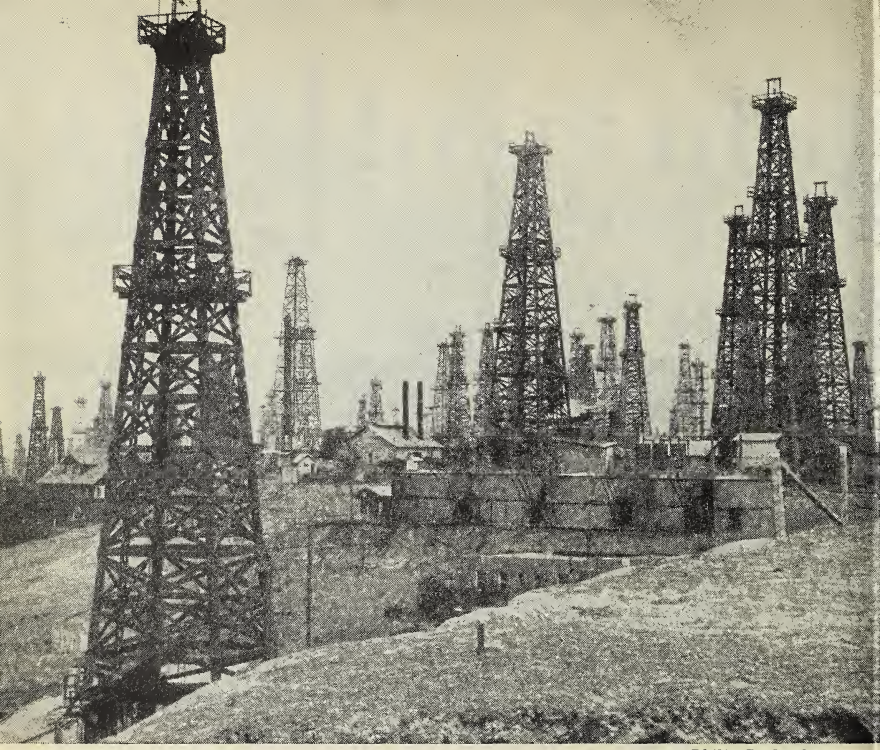


Courtesy American Petroleum Institute

CROSS SECTION OF AN OIL FIELD

Not all wells drilled in an oil field strike oil. Which ones in the diagram above did not? Why?

Suppose one of the owners discovers that there is oil beneath his land. What do his neighbors do? Knowing that the pool may extend beneath their own land, they begin to have wells bored on their own pieces of land, for they do not want the pool to be exhausted before they get their share of the oil. So, although the pool may not be very large and the world may not need an extra supply of oil just then, many new wells are opened up. In the great haste much oil is wasted by carelessness in opening the wells and more oil is produced than is needed.



Philip D. Gendreau

AN OIL FIELD IN CALIFORNIA

When there is an oversupply of oil, the price of oil is lowered and all the oil producers lose money. Besides, some of the oil must be stored to be sold later. It happens that oil loses some of its quality in storage. So another waste occurs when the quality of the oil is lowered.

What are some of the wasteful methods that result from haste in drilling the wells?

In the first place, many wells are drilled before the owners are ready to handle the oil. Often the oil spouts high up above the earth when the drill reaches the oil pool, and the oil rushes like a fountain for

Ewing Galloway

AN OIL WELL ON FIRE

days, scattering oil over the surrounding country. Such a well is called a *gusher*. Sometimes a gusher will spout for days before the oil can be brought under control, wasting thousands of barrels of oil.

Sometimes a careless workman will set fire to the oil jutting from the well, either by smoking or by setting off a spark in handling metal tools. When a well catches fire, it may burn for days and even weeks before the fire is brought under control and thousands of barrels of oil may be consumed.

Lightning may strike the derricks or machinery at the opening of an oil well and set the oil afire. Men

Lionel Green

A BLAZING OIL TANK

have learned how to protect their steel derricks and their machinery against lightning; yet often, when wells are hastily bored, the owners do not take time to use these means of protection against lightning.

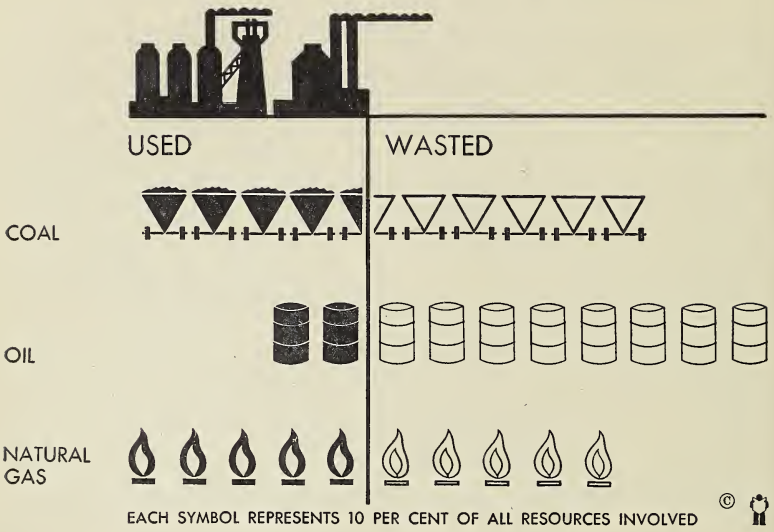
Pockets of natural gas are always found near oil pools. It is the pressure of this natural gas which pushes the oil up to the surface of the earth when a hole is drilled down to the oil pool. When there is careless or hasty work in boring wells, this gas is often allowed to escape, for it rushes right up as the oil gushes out. Men have learned how to save the gas for future usefulness. They have found a way of piping it back into the pockets surrounding the oil pool, where it may continue to help force the oil

up to the surface of the earth. Some of the oil-producing states have passed statutes to prevent the waste of gas. Still a waste often occurs.

In new oil fields it is easier to bring the oil to the surface of the earth than it is in the old fields. When a new well is drilled, the oil flows easily up to the surface of the earth, and sometimes even gushes up. Of course, oil that flows up easily can be produced at little cost. In older fields, where the wells have been drilled for some time, the oil pools are partly empty. So pumping machinery is necessary to raise the oil to the surface. Sometimes deeper drilling is necessary. As both pumping and drilling are expensive, it costs more to get the oil from the old pools than it does from the new.

Can you guess what has happened? The story of the coal mines will help you. Oil companies find it cheaper to open up new oil wells than to operate old ones. For this reason, more wells have been opened up than were necessary to supply the demand. Oil wells that might have remained storehouses for future use have been tapped and partly exhausted.

Oil is often discovered on the land belonging to someone who is not prepared to take care of the production and marketing of oil. In such cases the owner leases the "oil rights" on his property to an oil company that makes a business of producing and marketing oil. When oil is discovered in a new field, all the companies rush to buy up oil rights from owners of land in the surrounding territory and



Study the pictogram. Then tell the story of waste and production of each product.

to drill wells as rapidly as possible. Each company wishes to share in the new field. Then more wells are drilled and more oil is produced than necessary.

Our government and some of the oil producers began to see the evils of overproduction of oil and of the wasteful methods of production. In 1924 the government created a Federal Oil Conservation Board, a group of men whose duty it is to study the problems of oil production and to recommend better ways of handling our oil supply.

Several of the states which produce much oil have set up their own control of the oil output in their states. A limit is placed on the amount of oil

which each well or each company may produce. This method of control is called *proration.*

Sometimes an oil company will defy the state ruling and produce more oil than is allowed under it. Oil which is produced in violation of the ruling is called "hot oil." A law of our Federal Government, passed in 1935, forbids the shipment of "hot oil" from one state to another. In recent years some of our oil-producing states have united under an agreement called the Interstate Compact to Conserve Gas and Oil. Under this compact the states may agree to set a limit on the amount of oil produced by each state. The states are beginning to realize that co-operation in the production of oil is better than competition.

So, as you see, both our Federal Government and some of our state governments are seeking ways to handle the serious problem of conserving our oil pools and stopping the waste of oil. The government has also tried an experiment in production.

In California there is a new oil field called Kettleman Hills. It is a field thirty miles long and five miles wide. Oil men found petroleum there a few years ago. As the government owned some of the land in this oil field, it was interested in working out a way in which the oil could be handled without much waste. So some officers of the government held conferences with the private owners of this new oil field. They planned how it should be developed. And what do you think they decided to do?

They decided to drill one oil well on each ten acres of the land. All of the owners together would pay for the drilling of the wells, for pumping the oil, and for storing it. Then they would divide the oil among all the owners, each one getting his share of oil according to the amount of land he owned. By this method the expense and labor of building too many derricks and of drilling too many wells would be saved. By this experiment it has been discovered that one well for each ten acres is usually enough to supply all the oil that is needed without wasting the oil or exhausting the pool too quickly.

The method of co-operation used at Kettleman Hills is known as *unitization*, for the oil pool is developed as one big unit. There are organizations of oil producers who believe in unitization and who think it should be tried wherever possible.

There are people who believe that we are not going to need as much petroleum in the future as we do today. Already we are making engines for automobiles and airplanes which do not use so much gasoline as formerly. More and more we are learning new ways of saving by using less fuel.

Hydrogenation is the name of a new process by which gasoline may be made from coal. It is certain that if we continue to use petroleum at the rate at which we are using it today, we shall some day need to find a way of producing oil. But, it costs twice as much to produce gasoline by hydrogenation as it does to produce it from petroleum. In some

European countries which do not have a natural supply of oil, the production of gas by hydrogenation is already in use. However, we are still rich in our supply, and we shall find it sufficient for our use for years to come if we but handle it intelligently.

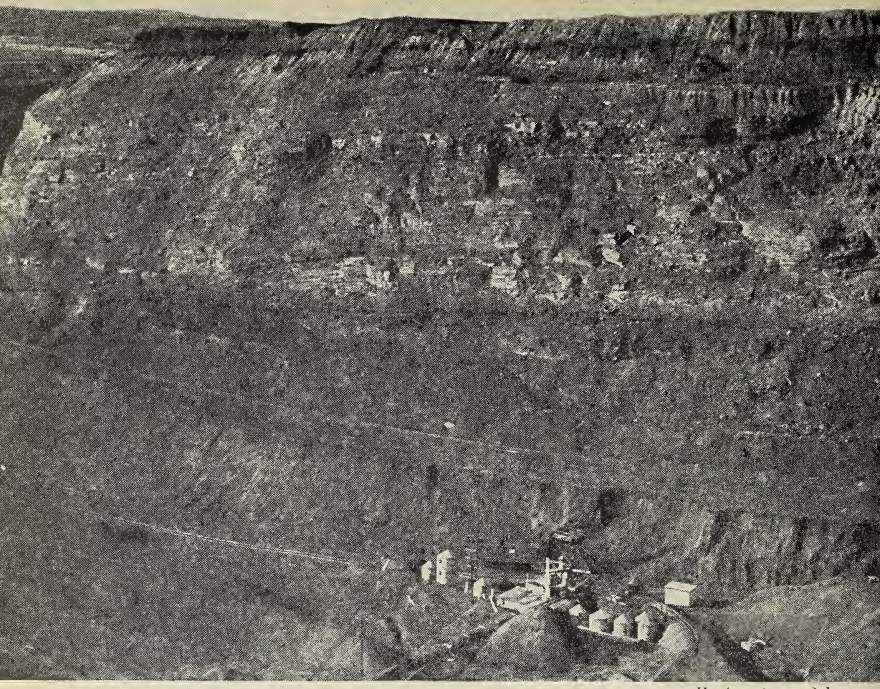
Finding Out More about Petroleum. I. In one of the books of science that you have collected, or in an encyclopedia, find out all you can about petroleum. Learn especially about: (1) the uses of petroleum, (2) its *by-products* (things made from petroleum). You will be quite surprised to discover some of the by-products.

II. For your Museum of Natural Resources make a collection of the by-products of petroleum.

SAVING OUR MINERALS

Modern civilization depends as much upon the metals within the earth's crust as it does upon the fuel resources. Without metals we could not have machines. Without machines we could not have factories. Without factories we could not enjoy many of the comforts and conveniences which we now have.

The conservation of metals is needed if people in the future are to have metals to use. The National Resources Board has estimated that, in the United States, there are only about fifteen million tons of copper that can be mined, not more than ten million tons of lead, and only about eleven million tons of zinc. These three metals are vastly important in



H. Armstrong Roberts

THE LARGEST IRON MINE IN THE WORLD
This is one of the open-pit mines of Minnesota.

the modern world. And yet, not seeming to realize that we may soon become dependent upon foreign countries for them, we continue to handle our metals in a wasteful way. In what ways are metals wasted? In what ways can they be conserved?

Metals are wasted in mining them, as coal is. The best ores are selected, and the ores with only a small percentage of metal in them are left untouched. The mines are closed before all the ore is extracted. The time may come when mineowners will have to return to the abandoned mines and to the poor ores. It will be a very expensive process to reopen these abandoned mines.

Ewing Galloway

A SMELTING PLANT IN IDAHO

Lead and zinc are mined near this smelting plant.

We waste many of our metals in using them. Metals can be used more than once. Old automobiles might be taken apart and the metal used in making new ones. Old machinery might be sold to manufacturers and the metal re-used. Some manufacturing plants use only scrap metal. Today old copper is used more than new. We sell a large amount of our scrap metal to other nations, who use it to make many beautiful and useful objects.

It is hoped that before our mineral resources are exhausted, new inventions and discoveries will help us in these problems. Scientists have already found some new methods of extracting metals from ores.

G. A. Douglas from Gendreau

DRILLING FOR COPPER ORE

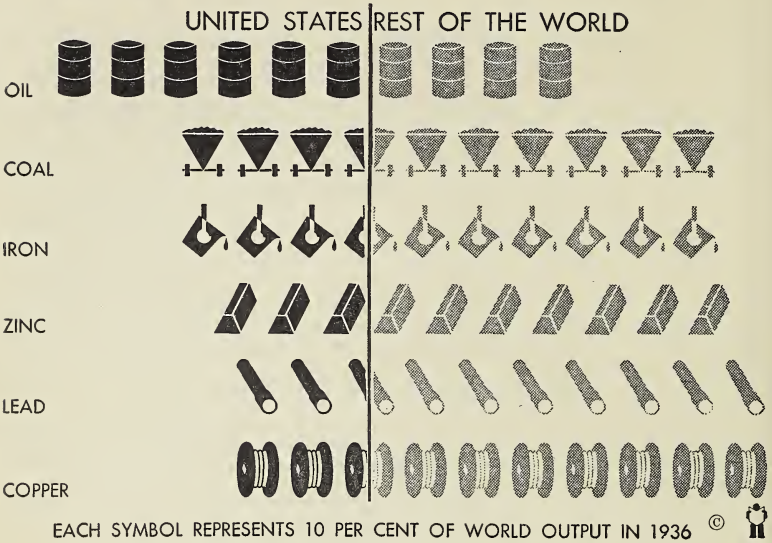
In many cases the pneumatic drill has taken the place of the early miner's pick.

By a new process of extracting copper from the ore, great heaps of cast-out ore have been reworked, and they have been made to yield profitable amounts of copper.

Scientists are also working on new products to take the place of some of our metals. We have little tin in this country, but we have aluminum in abundance. So science has shown how to make aluminum foil take the place of tin foil, which we have used heavily in the past. For some purposes, such as lettering, aluminum is being used in place of silver to produce a silvery impression. It is also possible to make radio cabinets, door handles, clocks, parts of automobiles, and many other objects once made from metals from substitute substances. Such substitute materials may be coated with metal so that they are beautiful to look at, as well as useful. Some of these substitutes are not yet in common use, but they will probably be used to a much greater extent in the future and thus make conservation of metals possible.

Does the fact that we are rapidly inventing new things mean that we may recklessly waste our resources? No, for we cannot estimate exactly when a resource may be exhausted. We do not know when we may need something which has not yet been invented. We need to be careful to use our resources only as we need them. We want each resource to last until we are sure we have invented something which will take its place.

THE UNITED STATES AND THE WORLD



Reading a Pictogram. Study the pictogram above. If the ten tanks of oil represent 100%, or all, of the world's output, how many per cent do the six tanks supplied by the United States represent? Find the per cent of the output of the United States for each product.

Stories about Mineral Resources. Look in some of these books for material on mining:

Coal and the Coal Miner by Homer Greene
The Story of Mining by Martha Gruening
Minerals by William F. Rocheleau
Diggers in the Earth by E. M. Tappan
Wonders of the Earth's Crust by H. E. Taylor
The Story of Oil by W. S. Tower

Reading about Mining Methods. Read in an encyclopedia about: *Mining, Copper, Zinc, Iron, Lead, Gold.*

VI. PLANS FOR THE FUTURE

The wealth of our country comes from the natural resources which have been provided so abundantly. How can the United States continue to hold its place as the richest nation in the world unless it finds some new and better ways of handling its natural resources?

WHAT DO WE NEED TO DO?

Men who are studying the problem of conservation are warning the people of the nation of the dangers ahead. Newspapers are carrying articles about the waste of minerals, the waste of forests, the waste of soil, the waste of water, and the waste of wild life. Books are being written to tell of the need for better control of these resources. The Congress of the United States has passed some laws to control the use of some of these resources. Universities, experiment stations, and government agencies of various kinds are sending out reports from time to time to furnish us with information about our waste and about the methods of conservation which scientists have discovered. Experts in different fields of science are warning, warning, warning the people of our country.

A wise use of natural resources is called conservation. Conservation is becoming an important problem in our country. People are pleading for conservation. The government is planning for conservation. How can the American people learn to use their natural resources wisely? How can they solve the problems of conservation?

The men who have thought about conservation tell us that five things are needed to make conservation a success. First, the people themselves must want conservation. Second, a complete study must be made of our natural resources to determine the amount and condition of each. Third, a study must be made of the needs of the people using the natural resources. Fourth, a plan must be made determining how the natural resources should be used. And fifth, there must be some way of seeing that the plan is carried out.

The people who know most about the problems of conservation are urging the people of America to provide means of studying these questions before it is too late. They want a group of experts working in each section of our country. It is a huge task. For example, each acre of land must be studied to find out the kind and condition of the soil, the depth of the topsoil, and the amount of erosion that is taking place. Each piece of land must be studied to determine the amount of slope, the amount of water that runs off the land, the amount of soil that is carried with the water, the amount of water that

soaks into the ground. Then the best use of the land can be determined. If the land is to be used for farming, the owner must be taught how to rotate his crops, how to fertilize his land, and how to cultivate his land to prevent erosion. Each of our natural resources needs this same kind of careful study.

The amount of each kind of goods needed by the population has to be considered, too, in making conservation plans. How much petroleum do the American people need for running their automobiles and trucks? How much oil do they need for lubricating their machines? How much coal do they need for heating their houses and running their engines? How much wheat do they need for food?

After this study has been made, a plan can be formed for the use of our natural resources in each part of the United States. There will be several parts to such a program. Each part of the plan must take into consideration several things. It must consider the people of that section of the country, their occupations, and their needs. It must consider the needs of all the people of the United States. It must consider the needs of all the millions of people who have not yet been born but who have a right to find the natural resources in good condition when they do come to live upon the earth. It must, at the same time, improve the condition of the land resources of the United States, making them vigorous and wholesome.

Such a plan would have to provide a program of use for all of the natural resources in each section of the country. Probably it would be divided in some such way as the following:

1. A land-use program which would decide what lands are to be used for farming, for mining, for industry, for forests, for pasturage, for cities. This part of the plan would have to provide for planting trees and grass, for moving people off some parts of the land and providing them with new homes, for controlling soil erosion, and for restoring fertility to the soil.

2. A water-use program which would provide for the irrigation of lands, for flood control, for the use of streams for navigation, for the use of water for power, and for the storage of water in the water table for the use of growing plants and for human use.

3. A transportation program which would provide for a new pattern of highways, railroads, subways, and airways. A new pattern is needed in these days of speed, in order that goods and people can be moved more rapidly without danger to life or property.

4. A wild-life program which would consider ways of preserving our birds, our animals, and our fish. It would suggest laws for the protection of wild life, and it would plan to establish sanctuaries for certain kinds of wild life. It would consider, also, what need the people would have for using certain kinds of wild life for food, and what need there is for preserving certain kinds of wild life that destroy insect pests.

5. An industrial program which would consider the best places for the location of industries, the grouping of industries to save transportation, and the establishment of new kinds of industries. It would consider the development of industries for making substitutes for metals and other minerals which are scarce, for using by-products for such things as paper and cloth, and for reducing the cost of manufactured products.

6. A social and economic improvement program which would consider better ways of living, better methods of city building, better ways of buying, a better distribution of wealth, better means of controlling health, and better ways of governing.

Would you like to have these six programs worked out in one big plan which would consider the needs of all the people of the United States? If you would, you need to get ready to help with such a plan. You need to study your land. You need to study the people of the land. You need to know this America of ours.

The Work of Conservation. I. Find out some of the things which are being done today to conserve our natural resources. Select one such piece of work and report on it to your class.

II. Explain why the work of conservation goes on so slowly.

III. People used to think that conservation meant not to use the natural resources. Explain why that is a poor way of looking at conservation.

THINKING IT OVER

Now that you have finished reading the story of our natural resources, their waste and their conservation, perhaps you would like to talk it over with your class. The following questions list some problems which you will enjoy discussing.

I. The people of the United States seemed to have the idea that their natural resources would never become exhausted. What has led them to think so? What has happened lately to make them think differently?

II. The conservation of wild life was not discussed in this story because there was not space enough to cover all these things. Can you give some examples of the waste of wild life in America? Do you know of some things that are being done to conserve wild life?

III. Why do people need to study the origin of the natural resources before they can really understand the importance of conservation?

IV. What do you think is the true meaning of the word *conservation?* Give some examples to show you have the true meaning of the word.

V. Which forms of waste seem worst to you? Which wastes seem most dangerous at the present time?

VI. What are some of the things for which you would provide if you were trying to make a conservation plan?

UNIT IV

WHAT IS MONEY?

Section I. Our Money Civilization of Today . . . . . page 401
Section II. Satisfying Human Wants . page 420
Section III. How Trade and Money Developed . . . . . page 435
Section IV. Civilizations Using Little Money . . . . . page 473
Section V. Money and Trade Today . page 499
Section VI. Our Government and Our Money . . . . . page 529

I. OUR MONEY CIVILIZATION OF TODAY

Today we live in a money civilization. What do we mean by a money civilization? In what ways is a money civilization different from a civilization which does not use money?

DR. FRANK ARNOLD'S WAY OF LIVING

Frank Arnold is a doctor. He makes his living by caring for sick people. He and his family live in an apartment house in a large city. His apartment has many modern conveniences. It has electricity for cooking, for lighting, for ironing, and for running the vacuum cleaner and the electric dishwasher. It has an incinerator chute down which garbage may be dropped and a dumb-waiter which carries up groceries from the basement. The apartment is comfortably furnished.

Dr. Arnold is a *consumer;* that is, he buys *goods,* such as food, clothing, and furniture for his family. He pays for *services,* such as electricity, telephone service, laundry service, and the use of an apartment. A consumer is a person who buys goods and services.

When Dr. Arnold buys goods, he has something which he owns. Some goods, such as food, he uses

up at once. Some goods, such as furniture, he may keep for a long time. When he buys services, he pays only for the use of something. He does not own the apartment or the telephone or the laundry.

Dr. Arnold carries a checkbook in his pocket. He writes a check to pay for his rent. He writes a check to pay for his clothing. He writes a check to pay for the fuel he burns and for the electric current he uses. He writes a check to pay for his groceries. He even writes a check to give himself spending money for carfare or motion pictures or ice cream.

When Dr. Arnold receives money from his patients, he takes the money to the bank and deposits it. That gives him the right to write checks to pay for the things which he buys. He has to keep a careful account in order to be sure that he does not write checks for more money than he puts into the bank each month.

Dr. Arnold makes nothing that he uses. He does not produce the food that his family eats. He did not build the house in which he lives; he would not know how to build a house for himself and his family. He spent his early years in school and college, learning to become a doctor; now he spends his time in giving a service to his patients. He does not produce goods — he gives a service. By giving this service, he earns the money with which to buy the goods and services which he needs.

Dr. Arnold knows that he can be a consumer only as long as he has money in the bank. Sometimes he

wonders what would happen to him and to his family if he could no longer earn money. How would he pay his rent, his grocery bill, his electric-light and gas bills? How would he be able to ride on the streetcar if he had nothing with which to pay his fare? Such thoughts make Dr. Arnold uneasy.

Sometimes Dr. Arnold thinks of his grandfather, Mr. William Arnold. He remembers that money was not very important to his grandfather. The next story will tell you why that was true.

MR. WILLIAM ARNOLD'S WAY OF LIVING

Mr. William Arnold owned a hundred acres of land. He raised hay and grain and fruit and vegetables on his land. He also raised some stock — a few head of cattle, some sheep, some hogs, and a few horses. He was a general farmer, raising small crops of a number of kinds.

Mr. Arnold lived in a good farmhouse on his land. His father and mother had built it and had brought up their family in it. It was a comfortable and roomy house. The materials for the house had come largely from the land — the timbers for the roof and framework from his father's woodland and the stone for the foundation from a quarry near by. His neighbors had helped his father build the house.

Mr. William Arnold had horses for his farm work and for driving. He had cows to furnish him with milk and butter and cream. He had sheep to furnish him wool. In the fall he butchered the calves which

he had pastured during the summer, and they furnished him with fresh veal. The pigs which he had raised furnished him with fresh pork and with ham and bacon. His poultry yard kept him well supplied with the freshest of eggs and with chickens and ducks for Sunday dinners.

Mr. Arnold had a good orchard. His father had selected the trees with care. Some of them produced apples for use during the summer and the early fall. From some of these early apples he made vinegar and cider. His wife made apple butter. She dried some of the apples for pies. Other trees produced apples which would stay sound and juicy the winter through. He stored baskets and barrels of these winter apples in the fruit cellar.

Mrs. Arnold canned peaches and plums and cherries. She made jam and preserves of raspberries, strawberries, and blackberries. She made fruit juice of grapes. All during the winter the good fruit of their orchard provided the Arnolds with food.

Mr. Arnold had a garden, too. His garden contained straight rows of every vegetable that he could coax to grow in that climate and in that soil. Mr. Arnold's wife could not use all the vegetables he produced. She canned and dried some of the tender corn. She made pickles of the cucumbers. She canned ripe tomatoes and pickled the green ones. She canned peas and beans. She stored carrots, cabbages, turnips, onions, and potatoes in the vegetable cellar for winter use.

Mr. Arnold raised grain and hay. In the spring he sowed the seed which he had selected and saved from the year before. He cultivated his land carefully. After harvest he stored in his barns enough grain and hay to feed his livestock through the winter. Then he sold the grain and hay which he did not need.

Mr. Arnold had a small piece of woodland. Each winter he cut down some of the trees which were full grown and cut them into firewood and into rails or posts for fences. He burned the firewood in his fireplaces and in his kitchen stove.

Mr. Arnold had a fair equipment of tools. Some of the tools were old, but as he kept them in good repair, they answered his purposes well. His plow and harrow and grain rake were horse-drawn, but they were quite suitable to the needs of a hundred-acre farm.

Mr. William Arnold worked very hard. He arose before sunrise each morning to feed and care for his livestock. He went into the fields each day from planting time to harvest time. He toiled long hours at heavy work under the hot sun. He came back at evening to milk cows and to feed his stock. On rainy days he worked in his barns, repairing farm tools, or went out to mend fences. Sometimes he was compelled to arise at midnight and go to the barn to attend sick cattle.

Mrs. Arnold worked hard, too. She cared for the home and cooked meals over a hot wood fire. She

fed the chickens, gathered eggs, and weeded the garden. She helped milk the cows, and she made butter. She canned fruits and vegetables. She made clothing for herself and her family. When the Arnold children were old enough to help with all of this work, they had duties to perform before and after school. During the summer vacations they worked all day, helping their father and their mother in the fields and in the home.

Mr. William Arnold was a consumer, just as was Dr. Frank Arnold. He and his family needed food and a home and clothing. But most of Mr. William Arnold's work did not earn money. It earned the goods and supplied the services that he and his family needed; that is, by hard work Mr. William Arnold produced most of the goods and services which he and his family needed. He did not have to think often about money. True enough, he sometimes had bad luck with his crops. A heavy storm might damage his grain crops, or a pest might destroy his apple crops, or sickness might take away some of his cattle. But he knew that most of the time, by his own hard work and by careful planning, he could be pretty sure to have the goods he needed to feed and clothe his family and the services needed to carry on the work of his farm. He was a consumer of the kind that could produce most of the goods and services that he needed to supply his family's wants. Since this is true, Mr. William Arnold can be called a *producer* as well as a consumer.

R. I. Nesmith

DEPENDENCE UPON THE LAND

Do these pictures of farm life help you to see why Mr. William Arnold might feel secure? In what ways?

Philip D. Gendreau

Mr. William Arnold owned his hundred acres of farmland and the house and barns that stood on the land. He owned the farm tools and machinery with which he worked. He owned horses and livestock and a wagon and a carriage. He owned the crops which he produced. Because he owned the things he needed to produce a living, he felt more secure than Dr. Frank Arnold.

MR. ALLEN ARNOLD'S WAY OF LIVING

Dr. Arnold has a brother, Allen Arnold. Mr. Allen Arnold learned to be a bookkeeper and, later, went to work in the office of a factory that made cotton goods. He was paid a salary at the end of each week. With this salary he paid for his food, his clothing, and the room which he rented. He also put some of his money each week into a savings account at a bank.

Mr. Allen Arnold learned much about the business of making cotton goods. He decided that he would like to own a cotton factory himself. When he had saved a sum of money, he rented a small building, bought a few pieces of the machinery necessary for weaving cotton cloth, and started his own cotton factory. He made good cloth, and he was able to sell it readily. He continued to save money and to plan for a larger plant; and the time came when, by using the money which he had saved and by borrowing some money, he could buy a piece of land, put up his own factory building, and buy more machines.

Now, with his larger plant and newer machinery, he is able to produce more goods.

Mr. Arnold has many expenses. He has to use the money which he receives from the sale of his goods to pay back the money he borrowed to build his new building and buy his new machines. He has to pay the salaries of all the men who work for him. He has to pay taxes on the factory property. He has to pay for the raw cotton from which he makes his cotton cloth. He has to sell a great deal of cloth to get enough money to pay all of these expenses.

In addition to paying the expenses of running his business, Mr. Arnold has to pay for the living expenses of himself and his family, who need food, clothing, and a home in which to live, besides other goods and services. By producing goods to sell to other people, Mr. Arnold earns the money to pay the living expenses of his family. Like Dr. Frank Arnold, he has many bills to pay. He has to have enough money in the bank to meet these bills. Although Mr. Allen Arnold is a producer, he is a consumer when he buys the necessities of living for himself and his family, and when he buys machines and raw cotton and the electric power to run his factory.

On the next two pages there are two maps which will help you to compare Mr. William Arnold's way of living with the ways in which Dr. Frank Arnold and Mr. Allen Arnold live.

Credit note: The maps on the following pages were made by Pictorial Statistics, Inc., for Co-operative Food Distributors of America.

ONE HUNDRED YEARS AGO THE HOME AND THE FARM SUPPLIED THE FOOD

TODAY THE WHOLE WORLD CONTRIBUTES TO THE PANTRY SHELVES

MONEY, GOODS, AND SERVICES

The three Arnolds represent three kinds of people.

Arnold, the farmer, was both a producer and a consumer who produced most of the goods he consumed. He owned a farm, some livestock, and some farm machinery. With these he produced goods; but instead of selling to others, he consumed the goods himself. He had little use for money, for the grain he raised went directly to his stables to feed his stock; the fruit and vegetables and milk and butter which he produced went directly to his home to feed his family. The leftover goods which his family did not need were often traded to pay for groceries or for clothing or for a doctor's services. Some of the leftovers he sold for money, and he used the money to pay his taxes or to buy a tool or a piece of new farm machinery now and then.

There are only a few people in the United States today who are like Mr. William Arnold. He produced most of the goods and services which he consumed. He needed little money with which to buy goods and services.

Dr. Frank Arnold owns little except the money he earns. With this money he buys the things he needs day by day. The goods and services which he buys have been produced by other people and are sold by these others for money. The method of living of Dr. Frank Arnold represents the usual kind of living in a money civilization.

H. Armstrong Roberts

DEPENDENCE UPON THE PAY ROLL

Most people today depend upon money for their goods and services.

Screen Traveler from Gendreau

PAYDAY IN JAVA

Money is a necessary part of living today. We work for money; that is, we sell our services. We pay money for our food, clothing, and shelter. We pay money for recreation, education, and to secure protection for our health, our lives, and our property.

The men who work in Mr. Allen Arnold's factory are dependent on money. They give their services to earn weekly wages. With these wages they pay for the goods they need. Bookkeepers, salesmen, teachers, ministers, officers of our city and state governments, public workers, such as postmen, policemen, firemen, and nurses — all these people give their services for salaries. Most of them are dependent upon their salaries for everything they need.

Ewing Galloway

PAYDAY IN THE UNITED STATES

None of them produce what they need. They earn money, and with the money they buy what they need.

Mr. Arnold, the factory owner, is a producer and a consumer. Like Mr. Arnold, the farmer, he owns goods with which he can produce goods. He owns a building and machines, and with these he produces cotton cloth.

The things with which a man produces are called *production goods.* The farmer's land and livestock and farm machines and tools are his production goods. The factory owner's building and machines are his production goods. Production goods are used to make products for consumers to use. The products which they make are called *consumption goods.* Mr.

Allen Arnold's cotton cloth, which he sold, is consumption goods. Automobiles, furniture, clothing, steel, and the food we buy are all consumption goods.

So Mr. Allen Arnold owns production goods, and with these he makes consumption goods. He has to sell much consumption goods in order to make enough money to pay for his production goods and their upkeep; to pay the wages and salaries of the people who helped produce the goods; to pay for the raw materials from which he made them; and to pay for the consumption goods that he and his family need. So Mr. Allen Arnold, the producer, has much need for money.

There are many producers, today. All the farmers who raise products to sell are producers. All the factory owners who prepare foods for our use are producers. The owners of factories that produce locomotives, railway cars, steel rails, automobiles, busses, clothing, china and glassware, furniture, books, newspapers, clocks, kitchen utensils, copper wire, telephones — all these are producers, and all have need for money.

Our civilization today is different from any the world has ever known. It is an industrial civilization and a *money civilization.* It is a money civilization because money is necessary to the very existence of most of the people who live in our country. It is the basis on which our whole living is planned. It is an industrial civilization because it depends upon the rapid production of all kinds of

goods for sale. That means machine production, of course. Goods produced by machines can be made more cheaply than those produced by hand. They can be produced more rapidly. Our machines make it possible for people to have an abundance of goods.

Machine-made goods are all around us. Our clothing is machine made. Much of our food is machine made. Our houses are largely machine made and are furnished with machine-made things. We go to machine-made motion pictures and listen to machine-made music. The production of these machine-made products requires the services of many people.

Are we comfortable in this machine-made money civilization of ours?

Some of us are not comfortable. Some are not secure, either, because we do not know from one month to the next whether we are going to be employed or unemployed, and because we do not know whether or not we shall have money for buying goods which we need. There are some disadvantages in living in a money civilization.

On the other hand, our standard of living is higher than it has ever been among any peoples in the world. Machine-made houses are more rapidly built than those made by hand, and more people can have them. Machine-made clothing is more rapidly made than handmade clothing. People in general have never been so well clothed as they are today. Machine-processed milk is purer than the milk which babies drank fifty years ago, and there is more of it.

Perhaps the difficulty is not so much a matter of the kind of civilization we live in as it is the way we are solving the problems of a money civilization. Perhaps we do not know enough about money — about what it stands for and about how to use it. The stories which follow in this Unit will tell more about money.

Different Ways of Living. I. If you were to have your choice, which home would you like best: that of Dr. Frank Arnold, or of his grandfather, or of his brother?

II. What differences would there have been in a day spent by the three men? Try to imagine a day's program for each one of them and list some of the things each one might have done.

III. Make a list of things which you think Dr. Frank Arnold may have worried about. Do you know any person who worries about the things on your list? What kind of consumer is he — one who buys what he consumes, or one who produces what he consumes?

IV. Study the two maps on pages 410 and 411. When you understand what they try to tell you, write two paragraphs — one to explain what the map on page 410 tells, and one to explain what the map on page 411 tells.

Production Goods. I. List the production goods on some farm you have visited. Make as complete a list as you can.

II. List some production goods that you think might belong to some factory owner.

III. Explain why Dr. Frank Arnold had no production goods. How did he earn money? How was he prepared to earn money?

IV. Explain: (1) why seeing and touching his possessions made Mr. William Arnold feel secure; (2) why Dr. Frank Arnold cannot feel as secure as did his grandfather. Do you think Mr. Allen Arnold feels secure? Do you think the workers in his factory feel secure?

V. List some of the people you know who are producers and who own production goods. Do they consume the goods they are producing or do they sell them?

Your Way of Living. I. List some of the different kinds of goods and services which your own family buys as a consumer.

II. Do you produce any goods or services for your family?

III. Explain as well as you can what you think is meant by a money civilization. Make a list of the things you have observed people doing today which show they are living in a money civilization.

IV. Give some good reasons why you think boys and girls should try to understand money — how it is used, and why it is used in such ways, and how it might be used.

Reading about Money. These two books will help you to understand how money is used today:

The Story of Money by Mary Duncan Carter
Man and His Riches by Mary B. Ambler

II. SATISFYING HUMAN WANTS

What do consumers want? Most of them want many things. They are constantly trying to satisfy their wants. What are the wants of human beings? How are they satisfied?

WHAT DO WE WANT?

"What do you want?" Ask this question of each person whom you meet in one day. You will receive a great many different answers. "Some candy," one might reply. "A pair of skates," another would answer. "A new book I have heard about." "A new hat." "A farm." "A long vacation trip." "A new watch." "A pearl ring." "A toy electric motor." "An automobile." "A radio." "A motion-picture camera."

So the answers would continue, on and on, most of the people naming some new thing which they want very much at that particular moment. All human beings have wants.

But the most important wants of people are those things which they need in keeping themselves alive. People need air to breathe. They can satisfy this want without much effort, for air is one of the few things in nature which are free to everyone.

They need food. Food, however, does not come free as a gift. Most people have to work for their food, and they are willing to do this, for food is necessary to their very lives.

People want protection from the weather. They must have clothing and some kind of shelter to keep the cold, the hot rays of the sun, and the rain or snow from making their bodies uncomfortable. Most people work hard to satisfy this want.

People want protection from injury and disease, too. They want safe places in which to live. Most people want clean, healthful surroundings. They want the advice of doctors and the care of nurses when they are ill or whenever their health is in danger.

People want happy homes. They want to feel safe in their homes. They want a place in which they can rest and a place in which they can care for themselves — prepare their food, bathe, and dress their bodies or mend their clothing. Most people want to live in families, for they feel better protected in small family groups; and they want to live close to the ones they love. But whether they live in families or alone, they want their homes to be comfortable and to be safe and to be happy.

People want means of transportation and communication. They are not content to stay all their days in one place or with one group of people. They wish to move about, and they want means of traveling in comfort and safety. They wish to keep in close touch with their friends who are at a distance,

and they want to know the things that are happening throughout the world.

Most people want to improve themselves. They want to become educated so that they will know how to do new things that will help them to live better. People need training to do the work they wish to do. Education is one of the greatest needs of people.

People want fun and pleasure. They want interesting things to do in the hours when they are not working or resting. Recreation is one of the most important wants of men. To satisfy this want, people must have a place in which to exercise and play. They must have things with which to enjoy life, such as pets and toys and automobiles and games and hobbies.

Some people want music and art and beautiful buildings and surroundings. Many of them want books to read and theaters and museums. They want a chance to develop their own talents so that they may create beautiful things. It takes many things to satisfy the want for beauty and the want to create beautiful things.

People want work. They want work for two reasons. First of all, people must work to earn a living so that they may satisfy the wants that have been mentioned. Second, they want work because work is interesting and because it gives them a chance to express the ideas and use the abilities which they have.

People want protection of their rights. They want laws which will protect their homes and their lands and their personal possessions. They want laws which will keep others from injuring them in any way. They want officers who will see that such laws are obeyed.

These are the principal wants of people. Civilized or uncivilized, people are much alike in their principal wants. It is true that uncivilized people do not want the same kinds or the great varieties of food that civilized people want. They do not want the same kinds of clothing or houses or vehicles. They satisfy their wants of travel in very simple ways. But they want food and clothing and shelter and protection just as civilized people do, and they are as anxious to satisfy these wants as are the people of your community.

We know, too, that even the most primitive people do some kind of work to get their food and shelter. They have some kind of tribal laws, and each tribe has a chief or leader who rules the tribe. Their education may consist of passing on to the youth the ways of fishing and hunting and fighting, of cooking and weaving, and of toolmaking that the elders know; but it is education just the same, and the members of the tribe prize such education. Uncivilized people have their ideas of beauty and of art, too, and they express these ideas in the decoration of their bodies and in crude drawings or carvings or pottery.

Hudson Historical Bureau

SATISFYING PRIMITIVE WANTS

See how many different ways of satisfying wants you can find in these pictures.

American Museum of Natural History

The advance in civilization over thousands of years has created more and more wants. The food wants have grown from the primitive wants for wild meat and grain and berries to the many food wants of today. The shelter wants have grown from a cave or a crude hut or tent to the fine homes and beautiful buildings of today. The clothing wants, transportation wants, education wants, pleasure wants, and cultural wants have all multiplied many times. But the wants are still the same — food, clothing, shelter, protection, means of travel and communication, education, pleasure, and beauty.

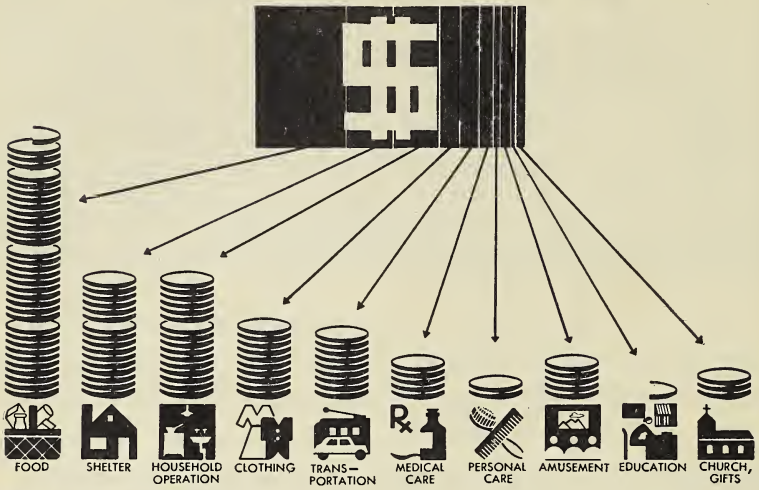
WORKING TO SATISFY WANTS

It takes great quantities of goods to satisfy the wants of all the consumers of the world. Some things have to be taken from the earth, as coal and oil and copper and iron. Some things have to be raised from the soil, as fruits and grains. Some things have to be manufactured, as dishes and cloth. The things which people use to satisfy their wants are called consumption goods.

So people work to produce goods. They raise food crops. They prepare and can foods. They mine coal and metals. They work in foundries to produce steel. They work in factories to produce tools and dishes and toys and glass. All these things are needed to supply people's wants.

But all the wants of people cannot be satisfied by goods. Consumers want services, too. They want

WHERE A TYPICAL FAMILY DOLLAR GOES*



This pictogram tells how we use money in our money civilization. Read the title above. Then read the legend. Notice the little pictures which represent the things which we buy. They represent our wants.

haircuts and shoeshines. They want to be served meals and to have their clothes cleaned and their housework done. They want to be nursed when they are sick and entertained when they are well. Such wants are satisfied by services. Many kinds of workers perform services — doctors, lawyers, teachers, ministers, waiters, carpenters, actors, musicians, electricians, nurses, cooks, and many others.

Today almost everything that is produced, whether goods or services, is produced for sale. It is bought by consumers. It is paid for in money. The money is used for buying goods and services.

* Prepared by Pictorial Statistics, Inc., for *How We Spend Our Money* by the Public Affairs Committee, Inc.

Buying and selling between producers and consumers is what we call *business*. Our whole civilization is built on the idea of producing goods and performing services for sale.

Your Wants. I. Make a list of your own wants. You might list them in columns, headed *Food, Clothing, Shelter, Pleasure, Travel, Communication, Education,* and any others you care to name. Then consider each want and decide what you do to satisfy it.

II. Do you think people's wants increase or decrease as they grow older? Make a list of the wants of some child in your family (a baby if there is one) and the wants of your father or mother. Which list is longer?

III. Make a list of the wants which your pet has. Is it as long as your list of wants? How does his way of satisfying his wants differ from yours?

IV. Try to get a list of expenses for one day in your home. Divide these expenses to show what your family spent for services and what it spent for wealth.

Why People Work. I. Explain what we mean when we say there is enough work in the world to keep all of the people busy. Why then are there so many unemployed people?

II. Do you think it would be a good idea for the class to make a chart showing the many kinds of consumption goods the workers of America make? Explain how you might make such a chart.

III. Make a list of ten kinds of workers who produce goods. List ten kinds of workers who perform services.

MONEY AND WEALTH

Two shipwrecked men were cast ashore upon a tiny island in mid-ocean.

"We are lucky," said one of them. "As the ship was sinking, I was quick enough to think of tying around my body this bag of money and jewels worth thousands of dollars. It contains enough wealth to keep me from starving for some time. Where is your pocketbook? Didn't you bring it with you? But even if you didn't, I have enough to share with you. I couldn't let you starve."

"I am only a poor sailor," the other man answered. "I had no bag of money and jewels. But I did some quick thinking, too. I grabbed this jug of water which you see strapped to my belt. And in my blouse in an oil-skin pouch I have a box of matches and a tin of sea biscuits. What is money in such a place as this? There are no people on this island from whom we can buy food — and it looks as though there were few plants and animals to provide us with raw food. If we find raw foods, we shall need fire with which to cook them. And we shall surely need fresh water. What are gold coins and diamond necklaces worth here? In a place such as this, the things we need most are food and fire and water. So it is I who really have the wealth this time. It is I who will have to share my wealth with you, for with all your money and jewels you have brought with you no real wealth."

Which of these two men was right? Which one did possess wealth? What is wealth? So often we are likely to think of money as wealth. But is it always wealth? Was money wealth in the story you have just read? Were the sea biscuits and water and matches wealth? Perhaps you need to think over the question of what wealth is.

Four things must be true of anything we call wealth. So we say that wealth has four necessary qualities or characteristics. Anything which lacks even one of these qualities cannot be classified as wealth. If you will remember what these qualities are, you will never be in doubt as to what is wealth and what is not wealth.

First of all, wealth is something which can be seen or felt or handled. It is a natural resource — something found in nature — or it is made from the natural resources. Trees may be wealth, or the lumber which is made from trees may be wealth. Soil may be wealth, as well as the crops which come from the soil. Coal may be wealth, and the coal mine, too. Dresses and skates and food and automobiles and thousands of other things may be wealth, for they can be seen and felt and handled. Anything which can be touched is said to be tangible. The word *tangible* comes from a Latin word meaning to touch. We say, then, that wealth must have *tangibility*.

Anything called wealth must be able to satisfy a human want. Houses and potatoes and blankets

and books and railway cars satisfy human wants. They have utility. A diamond ring may satisfy a desire for decoration. Therefore it has utility, and therefore it is wealth. But a nail which is needed to hold together two boards in a house is also wealth. To be wealth, a thing must have utility. So a second quality of wealth is *utility*.

A third quality which wealth must have is *scarcity*. An article which is free to everyone has no exchange value because it is not in demand. People will not buy it. They will neither give money for it nor exchange articles for it. The wind is not wealth, neither is the air nor the sunshine. Shoes, on the other hand, may be wealth, for they are scarce. There are not enough shoes to cover the feet of the human race. Shoes are in demand. People must work to fill that demand. Therefore shoes are wealth. To be considered wealth, an object must have the quality of scarcity, as well as of tangibility and utility.

Until land came into the possession of men, it could not be considered wealth. Coal was not wealth during all the years in which it lay hidden in the ground undiscovered by men. When men first learned to take coal from the ground, it became wealth because it belonged to the person or group of people who mined it. The coal in all the known mines today is wealth because it is owned by those who own the mines. Coal and land and forests became wealth when they came into ownership. We

say that *ownership* is the fourth quality of wealth. An article is not wealth unless it belongs to some person or group of persons.

Today, scientists know that many tons of gold are in the waters of the oceans. But this gold is not wealth. Will it ever become wealth? If men find some way of separating it from the water in large enough quantities to pay for their labor, the work and skill they use in doing this will make the gold theirs. Then the gold will come into ownership. It will also be tangible. It will be useful in satisfying wants. It will be in demand. When it has all these qualities, the gold that is now in the waters of the ocean will be wealth.

An article of wealth must possess these four qualities — tangibility, utility, scarcity, and ownership. All articles do not need to be equally scarce. They do not all need to be equally desirable. They may satisfy the wants of only a few people. They may be owned by a few people, or they may be owned by many people. But any article which has each of these qualities in some amount can be called wealth.

The Qualities of Wealth. I. From the following list, copy those things which you think may be called wealth. Be sure to be able to tell why you think the things in your list represent wealth.

A stray dog
A dollar bill
An oil well
A diamond ring
A book
A cloud in the sky
A sack of wheat
A bunch of violets

II. Do you know what the following terms mean? Can you show what they mean by using each of them in a sentence? You may need to use a dictionary.

tangibility	natural resource	producer
utility	consumer	wealth
scarcity	production goods	satisfy
ownership	consumption goods	want

III. Discuss the story of the two men who were shipwrecked. What point do you think it illustrates? Which man was the man of wealth during their stay on the island? If they were rescued and taken to a civilized country, which one would be considered a man of wealth? Why?

IV. Have you ever been in a situation in which money was not wealth? Explain why it was not. Was any other thing wealth at that time?

V. Explain how the scarcity of an article of wealth affects the price of the article. Give a good illustration of this.

VI. Mention three articles which you think have tangibility. Mention something which you think does not have tangibility.

VII. Does a bouquet of roses ever have utility? Explain your answer. Name four or five things which do not have utility.

VIII. Mention four natural resources and name one kind of wealth made from each.

SERVICES AND WEALTH

Many people work at producing goods, or wealth; that is, they produce the things which satisfy human wants. These things have tangibility, utility, scarcity, and ownership. The work of people changes natural resources into wealth.

Many people also work at performing services. The waiter in a restaurant does not produce goods — he gives a service. The barber, the dressmaker, the laundryman, the postman, the doctor, the nurse, the teacher, the officers of your state or city — all these people produce (or perform) services which help to satisfy human wants.

How is a service like wealth? First, it satisfies a human want. Second, it is scarce; that is, it has to be produced — it is not given free to all, as are the air and sunshine. Third, it is owned; that is, the ability to perform a service belongs to the person who gives it. He can refuse to give it, or he can sell his service to anyone whom he chooses. A service is owned, in the first place, by the person who performs it.

A service is different from wealth in one way. It does not come from the natural resources. For that reason, it is not a thing which can be felt or touched or seen. Wealth is produced when men turn natural resources into things of use by means of labor and skill. Services are the labor and skill which are required to produce articles of wealth.

Some of the most important work done today is in the production of services and not in the production of wealth. What sort of work is the President of the United States doing? Is he creating wealth or is he performing services? What kind of work is being done by the people who write books or by those who paint pictures or by those who produce plays? What kind of work do lawyers do? What kind of work do ditchdiggers do?

The people who create wealth have the wealth to show for their work. They can point to the banks and hotels and cloth and automobiles which they have helped make. A judge, a doctor, or a teacher may perform valuable services, but it is not always easy to see just what he has accomplished. Yet some of the most difficult work and some of the most important work is being done by service workers.

The Production of Services. I. Explain the difference between wealth and service.

II. Mention ten kinds of service which you need in order to live well.

III. Mention some service workers that the city employs. Collect pictures showing service workers.

IV. Mention three service workers who do not need to have a great amount of training to do their work. Mention three service givers who have to be highly trained in order to do their work acceptably

III. HOW TRADE AND MONEY DEVELOPED

Although primitive people had the same wants as we have today, they did not satisfy their wants as we do. How did they first create what we now call wealth? How did they learn to possess property and to exchange their goods?

FROM FREE GOODS TO WEALTH

At one time, thousands and thousands of years ago, everything in the world was free. The land was not owned by anyone. The forests were not owned. Wood and stone and plants and animals and gold and soil were as free as the air or as the sunshine and the winds. More than that, nobody wanted to own anything. People of the earliest times did not know what ownership meant, and it took thousands of years for the idea of ownership to develop.

We know, of course, that those early people had the same real wants which we have today. They became hungry, and their bodies needed food. They went forth, gathered food, and ate it. They felt tired, and their bodies needed rest; so they lay down on the ground and slept. Their bodies suffered from the cold or from sharp stones or briers, and they

wrapped themselves in animal skins. They wanted fun and amusement; so they invented games. They needed to communicate, and they devised signals, such as the tom-tom. Wild animals threatened them, and they invented weapons for defense.

These early people used the free goods of the forests in satisfying their wants. Fish filled the waters. Birds filled the air. Wild animals roamed in the woods. Plants grew in abundance. Of all these things in nature there was enough and to spare. Primitive men helped themselves to what they could get and lived as comfortably and safely as they could.

As long as people were content to use the things that were free in nature, there was no such thing as wealth. The food gatherers did not have wealth. They did not own anything, and they did not make things of use from the natural resources.

In time, however, some of the food gatherers became dissatisfied with the ways in which they were living. Nobody knows why they became dissatisfied. Perhaps the wild animals increased in number or in fierceness, so that men could no longer run away from them but had to fight or be killed. Perhaps the wild animals ate up the plants and small animals, so that men had to find other ways of getting food. Perhaps plants became scarce because of some change in climate. Perhaps men became dissatisfied with the kind or the quality of their food and hunted for those things that tasted better. At any

The Bettmann Archive

EARLY MEN MAKING WEAPONS

rate, something happened that made men willing to put forth a greater effort to live more safely and more comfortably.

Men who have studied primitive people tell us that weapons were probably the first things that men ever made. They fashioned them from bone and wood and stone. They shaped them by burning, hacking, cutting, or breaking the wood and bones; and by chipping and grinding the stones. It was hard work to make these first weapons. Primitive men had no patterns to go by. They lacked tools to use. They had little knowledge of the materials

or skill in using them. And yet they learned to make knives and spears and bows and arrows.

The first weapons must have been very crude. But did they have the qualities of wealth? They did. They were made of the natural resources — wood and stone and bones; so they had tangibility. They were used in satisfying human wants — protection from the wild animals and a means of getting a supply of food; so they had utility. They were owned by the tribe. And they were scarce, for it was not everyone who had the patience or the skill to make weapons. So the very earliest possessions of men had the four qualities of wealth.

The early weapons must have been highly prized. Probably those early hunters treasured them above everything else. They had been fashioned with their own hands. Someone had chipped and scraped the hard stone. Someone had spent long hours of time on every knife or spear or arrowhead made. Perhaps the hunters kept them in their hands even while they slept, for they would not wish to run any danger of theft.

Making weapons from the natural resources was an important step in human progress. Weapons changed men's ways of living. The food gatherers became hunters. For the first time, people were able to satisfy their wants by using products of their own labor and skill to procure the necessary goods.

This great step in progress was taken at different times by the different groups of people, living in the

various parts of the earth. Probably each group began creating wealth whenever conditions made its people dissatisfied with the way in which they were living. In those parts of the world where plants grew easily and where food was in abundance, men did not become hunters at an early date. They were satisfied to live as food gatherers. In those parts of the world where food was scarce, men were forced to help themselves by the invention of weapons. There are tribes living today who have not developed much beyond the stage of food gathering.

Using Free Goods. I. Describe the conditions of living as you imagine them to have been at the time when the natural resources were free. Explain why people did not at first care about owning land or flocks or houses.

II. Tell what natural resources are.

Making the First Weapons. I. Describe what may have happened to suggest to some primitive man the invention of the first weapon.

II. List some differences in primitive men's activities before and after they had invented weapons.

III. Find a description of a hunter of today and read it carefully. What did the hunter do that those early hunters probably did also?

IV. Name four qualities which the first weapons had to have in order to be wealth. Show how the first weapons possessed each of these qualities. Did they possess more of any one quality than of the other three?

FROM GROUP WEALTH TO PRIVATE WEALTH

People who study the savage tribes of today tell us that the members of a tribe travel together, hunt together, and fight together. They share in the ownership of the shelters, the hunting grounds, and the food. When there is not enough food for all of the tribe, the hunters make long journeys to find wild game for meat. Sometimes they separate in their search for game, each man going his own way. When one hunter is fortunate enough to kill a deer, does it belong to him? Indeed, no. The deer belongs to the tribe. The hunter must take it home to the people to whom it belongs. The members of the tribe must all share in the hunter's good fortune. If a hunter should fail to share his game with the tribe, it would be the same as stealing in the eyes of most primitive people.

Many of the primitive people of today who live in Australia and South America and Africa do not have private ownership of wealth. All the wealth, whatever it may be, belongs to the tribe. We say they have only tribal ownership.

It is thought that private ownership came to men through the taming of the grass-eating animals. At first, each tribe kept all of its tamed animals in one large flock. The men drove their animals from one pasture land to another, and all the men helped care for the livestock. These flocks and herds were a new kind of wealth, and the tribesmen were proud of

them. Everyone in the tribe had his share of the milk and wool which the animals produced.

But as years went by and as more young animals were born, the flock became very large. In time, it became too large to be well cared for. The men of the tribe were not able to feed all of the sheep or cattle or camels on one pasturing ground. They could not protect so many animals from the wild beasts. For this reason, it is thought, the tribesmen began to divide the animals into several small flocks and place a shepherd in charge of each flock.

As each shepherd tended his animals, he took great pride in them. The animals grew to know the shepherd who cared for them, too. They obeyed his voice, and often the shepherd was willing to make great sacrifices for his flock.

In time, each shepherd came to use for himself and his family the milk and wool produced by the animals under his charge. Soon the shepherd began to think of the little flock as the source of his family's food and clothing supply. He even began to think of the animals as belonging to him, since their milk and wool belonged to him.

Sometimes a shepherd had to take his flock some distance from the other flocks in order to find a better pasture. At such times, he was responsible for the safety of his flock. The other members of the tribe began to speak of the flock by the name of the man who had it in charge. They spoke of Nahum's flock or David's flock. This custom also

made the shepherds think they owned the animals they herded.

After hundreds of years the shepherds forgot that the tribe had ever owned the animals of the flock. They considered the animals the private property of the man who cared for them. It was only when the flocks were attacked by strange tribes that the shepherds seemed to remember tribal ownership. Then they fought for all of the animals, and everyone helped protect the property of each shepherd.

Often a tribe of shepherds settled down to live in some fertile river valley where the pasture was good all the year. Many times such a shepherd tribe became farmers, raising plants as well as animals. At first, the whole tribe owned the land. Each shepherd-farmer fed his animals where he thought the grass was good and planted his seed wherever he could find a suitable place. In time, each farmer came to plant his seeds in the same piece of ground, year after year. The one who had planted the crop harvested it. After using the same land, year after year, a farmer came to think of it as his private property. He disputed the right of anyone else to use it. When he died, he left to his son the right to that particular piece of land. So private ownership of land came about.

Sometimes it was the king or chief who started the idea of private ownership. He claimed all the land of the tribe for himself. Then he let each member of the tribe have a little piece to grow crops

on. Each farmer had to give the king part of his crop in return for the use of the land.

In time, people began to own other things, too. They owned houses because they were built upon the land which they tilled as their own. They owned grapevines because they had planted them. They owned tools because they had made them. They owned olive trees because they grew on the land which the men thought belonged to them. They owned clothing because they had made it. All of these things became privately owned wealth.

After men learned to own property privately, they had to learn to protect it. They drove people away from their land and flocks. They learned to lock up the things they prized most. They learned to hide things. In time, the tribe learned to make laws protecting the private property of each member of the tribe.

Private Ownership of Wealth. I. Be prepared to tell how early men probably learned to own animals.

II. Explain why, in the early days, the tribe owned weapons and flocks. What is the difference between tribal ownership and private ownership of wealth? Describe how private ownership developed.

III. Name some wealth which is your own private property. Name some wealth which belongs to your community — county, city, or state. Do you feel differently about your private property from the way you do about the property you own as part of a community?

THE BEGINNING OF BARTER

Buying and selling may seem very simple to you. Trading one article for another may seem very easy, too. Perhaps you have two boxes of crayons, but you do not have a paintbrush, and you would like to have one. Your friend next door has two paintbrushes but no crayons, and he would like to try his hand at using crayons. What happens? You agree to trade one of your boxes of crayons for one of his paintbrushes. By trading articles of wealth, each of you has satisfied one of your wants.

You could have satisfied your want by going to the store and buying a paintbrush, because you have money. Money can be exchanged for some object of wealth that will satisfy a want. The idea is not new to you because you have often been in a store.

But thousands of years ago people did not know that they could satisfy wants by trading or by purchase. They did not have money; so they could not offer it in exchange for the things they wanted. Before they owned property, they could not exchange one kind of goods for another.

How then did people ever learn to exchange goods?

Exchange began as gift making. It began by one tribe's giving presents to a visiting tribe. In the early days, when strangers arrived in a community, they were given food and gifts. In return, they offered gifts to the tribe which they were visiting.

When the guests were ready to return home, they again exchanged gifts with the tribe.

What were these gifts for? They were a form of courtesy. They were intended to make the two tribes friendly toward each other. Usually, the gifts were things of use. Usually, too, they consisted of things which one tribe had in abundance and which the other tribe lacked. Farmer tribes made gifts of grain. Shepherd tribes made gifts of wool or of young animals or of woven cloth. Elephant hunters made gifts of ivory. Sometimes a tribe would send enough red ocher to paint the body of the tribal chief and receive in exchange a bag of salt.

And so, the first exchange of goods was an exchange among friends — a way of showing friendly feelings. Gift making was accepted by primitive people as a fair way of exchanging goods.

As the years went by and as the standard of living improved, people began to want a greater variety of goods. The fishermen grew tired of eating only fish; they wanted grain, also. The farmers grew tired of eating only grain; they wanted wild meat, too. The hunters grew tired of eating only wild meat; they wanted fish and grain. Men wanted knives and boats and ornaments and clothing. Some of these things they could not produce for themselves. They could get them by exchanging the things they did not want for the things they did want. This exchange of goods which was not an exchange of gifts is called *barter*.

La Varre from Gendreau

PRIMITIVE BARTER TODAY

Natives of South America float mahogany logs down to the trading post on the coast.

Perhaps a man had more grain than he could eat. Another man had more meat than he could eat. The two men were friends and trusted each other. They exchanged or bartered some of their products, and each of them had a greater variety in his diet. They had both profited by the exchange of goods. By the exchange, both men had satisfied a want.

Barter developed early. However, it probably did not develop in some places until after the tribes had given up the custom of tribal ownership and had learned to enjoy private ownership of wealth.

La Varre from Gendreau

SELECTING GAY CLOTHS

At the trading post the natives take cloth, salt, and other necessaries in exchange for their logs.

Barter is a natural way of satisfying human wants. What could be more natural than to exchange the goods one does not want for those one does want?

As men continued to use barter, they found it had certain disadvantages. In the first place, *barter furnished no way of measuring the value* of two articles which were to be exchanged. For this reason, it was difficult to be fair and honest. Who could say whether a cow should be of more value than a horse? Or a horse than a sheep? Or a piece of land than a herd of goats?

In the second place, *barter furnished no means of making change.* Many products, such as livestock, cannot be divided into small portions. What if two men did agree that a cow was of more value than a lamb? The man who wanted to give the cow in exchange for a lamb had no way of getting back part of the value of the cow.

In the third place, *the barter system provided no way of saving for the future.* Suppose a man had more wheat than he could use. Suppose, too, that none of his neighbors were willing to take wheat in exchange for something else. Could the man save wheat for future use? In time, the wheat might spoil if he did.

In the last place, *barter was inconvenient.* Was it easy for a man to take a camel about until he found someone who had sheep's wool to spare and who would be willing to trade him some wool for his camel? If you wanted a pair of shoes badly, would you like to start out to hunt someone who would give you shoes in exchange for an extra chair your family did not need?

It was in trying to overcome these disadvantages of barter that people learned to take the next step in exchanging goods. You will read about it in the next story.

Gift Making. I. Explain why the people of early tribes had very little chance to learn to trade goods.

II. Why did primitive people feel they must share food with one another?

III. What gifts do you think the early people gave to members of other tribes who visited them? Make a list of the things which you think might have been used as gifts.

The Use of Barter. I. Select the important points in this chapter. Write each important point as a topic sentence. Under each topic sentence write the facts which further explain what the topic is about.

II. Explain the meaning of *barter*. Give an illustration of barter and show some of its disadvantages as a way of trading goods.

III. Have you ever used barter as a way of exchanging goods? Describe the bargain you made.

IV. Can you think of any ways in which barter is used today among people who are carrying on business?

GOODS AS A MEDIUM OF EXCHANGE

As men continued to barter their products, they learned many things. For example, they learned that some things were not in great demand — that only a few people wanted to own them. They learned that other things were in great demand — that almost everyone wanted to own them. They learned, too, that those things which were in great demand could be exchanged quickly and easily. For this reason, they found that it was safe to own things which people generally desired. There was less danger of having those things left on hand, with nobody willing to take them in exchange for other goods.

For example, people in Northern Africa, Western Asia, and Southern Europe found that most men liked to own tamed animals. Most of all they wanted to own cattle. Just any kind of cattle? Yes, all cattle were considered valuable; but there was one kind that was more popular than any other kind. That kind was the milk-faced or white-faced ox. Indeed, white-faced oxen were in such demand that one could be exchanged almost anywhere, at any time. These oxen were a possession of much value, and they were therefore desired by almost all people.

Gradually men began to state the worth of other things in terms of the milk-faced oxen. A suit of armor was said to be worth ten milk-faced oxen. The oxen became a measure of value. A man bought the suit of armor by paying ten oxen for it. Then the ox became what is known as a *medium of exchange*.

A medium of exchange is a third article that is different from two articles to be exchanged. Suppose a man who owned some grain needed a cart. Instead of trading some grain for a cart, he sold the grain for an ox, and then bought the cart by trading the ox for the cart. The ox, a third article, was the medium of exchange for the grain and the cart. The money we use today is our medium of exchange. We trade some goods for money, or we trade our services for money; then we trade the money for some goods which we want. A medium of exchange

is also a *measure of value.* Men said in early times, "This armor is worth ten oxen." We measure the value of goods today in money by saying, "This book is worth one dollar." When the early people learned to use the milk-faced ox as a medium of exchange and as a measure of value, they had taken an important step in the business of exchanging goods.

In time, other cattle were used as a medium of exchange; that is, cattle became money. Other animals became money, too. Sheep were sometimes used as we use small change. They were exchanged for goods of small value. Perhaps ten sheep were equal in value to an ox.

People have used goods other than cattle for a medium of exchange. Some groups have used things to eat — cacao beans, grain, nuts, fish, salt.

Articles valued because of their use in religious services have been used — incense which worshipers burned at the altars; dishes used for holding the blood of the sacrifices. Things which were generally acceptable as tribal gifts have been used — ivory, teeth, stones, spices, rugs, or blankets. Men have used the things they wore as a medium of exchange — skins, furs, cloth. In fact, anything that could be easily exchanged because of its usefulness or its value to people has probably been used as a medium of exchange at some time.

Many groups have used ornaments as a medium of exchange — rings for the nose or arms or ears or the fingers. People have always been interested in

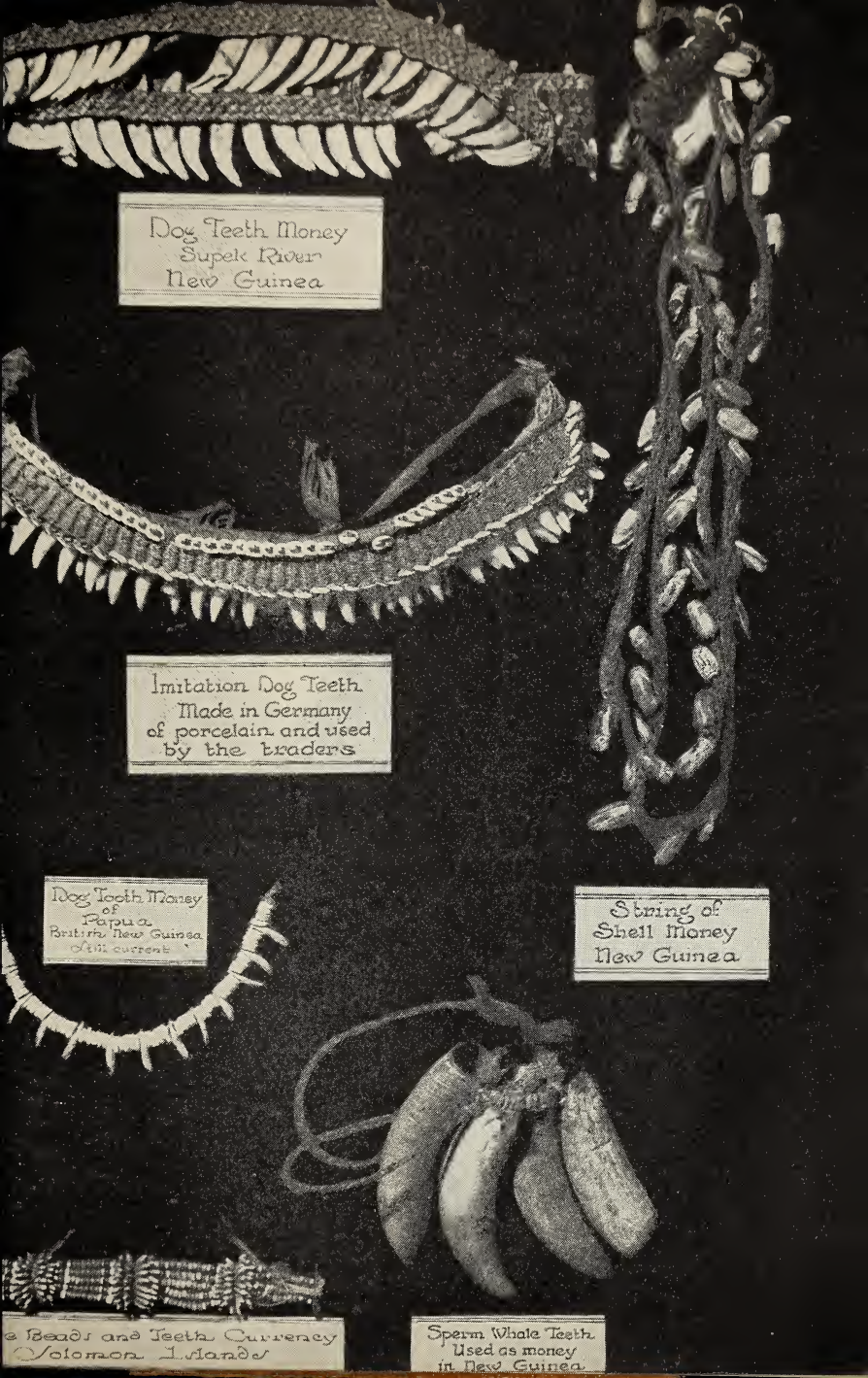
wearing ornaments; so in many places ornaments came to be used for money. Ornaments were prized by everyone. Gold and silver were used by early people for making rings and necklaces and bracelets. Such jewelry was used as money by people who prized it. It was the exchange of gold and silver ornaments that led the early people to the use of gold and silver in the making of coins.

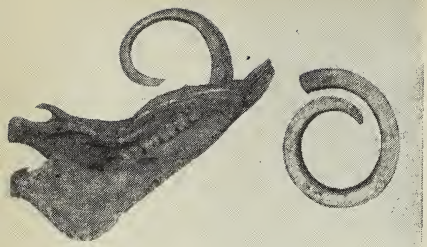
An article of goods, such as an animal skin, a measure of grain, or a metal ring of gold or silver or copper, is called a *commodity*. Any commodity which provides both a medium of exchange and a measure of value is called *money*.

Any commodity which has been used as money was itself useful to man. The ox is a good example. If a man had an ox, it could be used as money. If the man did not need to buy anything, he could keep the ox and use it to pull a plow. It might drag his cart as he moved to new pasture lands. It might turn the wheel that pumped water. The ox was in this way satisfying human wants — it was wealth. But when the time came for the man to buy grain, he could take the ox to market and use it as a medium of exchange — as money.

But suppose that food had become scarce — that the man had been compelled to kill his ox for food. What was the ox then? Was it a commodity used in satisfying human wants? Or was it money?

Credit note: The picture on the opposite page is reproduced through the courtesy of the Buffalo Museum of Science.


Dog Teeth Money
Supek River
New Guinea
Imitation Dog Teeth
Made in Germany
of porcelain and used
by the traders
Dog Tooth Money
of
Papua
British New Guinea
Still current
String of
Shell Money
New Guinea
Beads and Teeth Currency
Solomon Islands
Sperm Whale Teeth
Used as money
in New Guinea



Boar-tusk money is used today in New Guinea. The tusks are often worn as ornaments by the natives. The ivory is of value itself as a commodity in trade.

Courtesy Buffalo Museum of Science

Brick-tea money is used in Siberia, Mongolia, and Tibet today. It is made of leaves and stalks of the tea plant, mixed with oxblood, and pressed into a brick. It can also be made into a refreshing beverage.

Keystone View Company

This fiber mat is used by Samoans as money and also in their religious ceremonials. Native women weave these mats from plant fiber.

Courtesy Buffalo Museum of Science

Natives of the Santa Cruz islands use coiled feather money. It is made of feathers from the small red headdress of a jungle bird. Attached to vegetable fiber coils are charms that the owners think protect them.

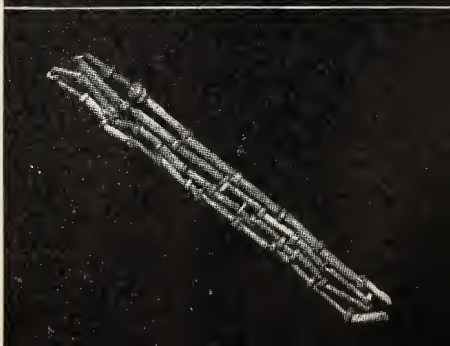
Courtesy Buffalo Museum of Science

This French trading ax was used as money by the early explorers and settlers in America. The axhead at the right was found in a burial mound near Georgian Bay.

Carved stone axheads like the one at the right were used by the ancient tribes in Mexico as a medium of exchange.

The hand-wrought stone beads at the right were made by the Indians around Puget Sound. They were used as ornaments and as money by the early tribes.

The beads pictured at the right were taken from a tomb near the Nile River in Egypt. Such beads were used as money by the early Egyptians.



Courtesy Buffalo Museum of Science

Even gold rings could be a useful commodity. They could satisfy a human want for beauty. The owner of the rings could wear them for adornment. As an adornment they were a commodity — they were wealth. But when the man took off one of the rings and traded it for a horse which he wanted, it became money.

Commodities as Money. I. Explain clearly the difference between the use of barter and the use of a commodity as money in the exchange of goods.

II. Make a list of the kinds of money used before coins were made.

III. Why, do you think, did settlers in a new country often use commodities as money before they used coined money?

IV. Find out about the money the Indians used at the time the white people first settled this country. What word will you look for in the index of a history?

V. Can you think of any reason why the milk-faced oxen were more greatly prized than other cattle?

THE USE OF METALS AS MONEY

The discovery of copper by some of the people of the ancient world introduced a new commodity of much value. People began to make pots of this metal. They liked their copper pots better than those made of clay. Copper pots were durable and did not break easily. Nearly everyone wanted to

own at least one copper pot in which to cook food. Because of this demand for them, merchants accepted copper pots in exchange for any articles which they had to sell.

As soon as copper pots were accepted in payment for all kinds of goods, they became money, just as cattle had become money. A copper pot made better money than an ox for several reasons. It did not stray away from its owner. It did not have to be fed. It was smaller and was, therefore, more easily carried about. A copper pot represented a smaller value than an ox had represented. For that reason, it could be used in the purchase of small articles.

In time, other articles were made of copper, and some of these also became money. People made knives, bowls, ornaments, weapons, and tools of copper. None of these articles, however, had quite the demand that copper pots had; so they were not always acceptable in exchanging goods. For this reason, they did not make as good money as copper pots.

Finally someone had a great idea. Instead of making copper into pots, he made the copper into long thin rods. Each rod had a certain weight. Such a rod was called an *obolus*. The obolus was very slender. A man could grasp six oboli in his hand.

The obolus was a usable commodity, just as was an ox or a copper pot. If the owner wished, he

could melt and mold a number of oboli into something to use — a copper pot or a bowl or a knife. But as long as the obolus remained a copper rod, it could be used only as money.

The use of the obolus marked a great step forward in the history of money. People began to think of the obolus as something with which to make purchases; that is, they thought of it only as money. Perhaps they often forgot that the copper rods were also a useful commodity which could be made into bowls or pots or knives.

Along the Mediterranean Sea the obolus became a measure of value and a medium of exchange for many groups of people. An article was said to be worth so many oboli. Even copper itself was valued in terms of the obolus. The obolus was accepted everywhere by traders.

The obolus made better money than cattle. The traders liked it better because it was not so hard to carry. Many traders in those days traveled in boats. The boats were small, for they had to be moved with oars and sails. Space was important, and traders did not like to accept cattle in exchange for clothing or weapons or wine or pottery. Cattle took up too much space. Then, too, the traders traveled from island to island over the Great Sea, sometimes not returning for months. Cattle could not be carried so far over the rough waters. So the early traders liked to be paid in copper for the articles which they had for sale.

Hudson Historical Bureau and Courtesy Buffalo Museum of Science

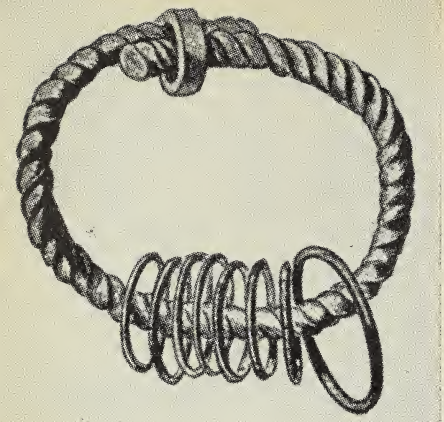
EGYPTIANS WEIGHING GOLD AND SILVER

These drawings were found on the walls of Egyptian tombs. In the picture at the left, an ox-shaped weight is used to weigh metal. In the right-hand picture, the weight is in the shape of a lamb. The Egyptians valued gold and silver in terms of cattle.

Traders did not always get the copper rods for their merchandise, however. They had to take what the people had to offer, and many times they were paid in furs or tin or cloth. But they measured the value of these things in terms of the obolus. This helped to make trading satisfactory to both sides.

As the traders went from island to island with their copper rods, more and more people came to see the advantage of having metal money. In time, many of the people in that part of the world were using copper pieces made in various shapes and sizes.

In Egypt copper rings were used for money. These rings had to be weighed each time they were used. For that reason, trading was slow and difficult. Only the nobles, the priests, and the Pharaohs of Egypt used metal ring money. The common people still used barter for such trading as they carried on.

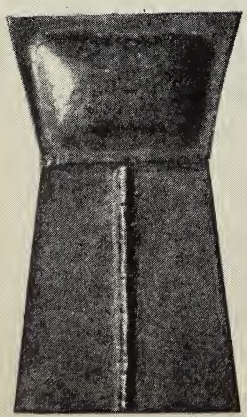


The bronze armlet at the left was found in Switzerland in a Lake Dweller's village. Such an armlet was an ornament and also money. The small rings could be removed and used as coins.

Hudson Historical Bureau

Bars of iron, like the one pictured at the left, were used by the Vikings as money as early as A.D. 1000. Six bars would purchase a horse.

Courtesy Buffalo Museum of Science



Before the coming of white men, some Alaskan Indians used copper plates for money. Some of these plates weighed as much as one hundred pounds and were worth several thousand blankets. Some were only a pound in weight. The plates were made from copper nuggets found in river beds.

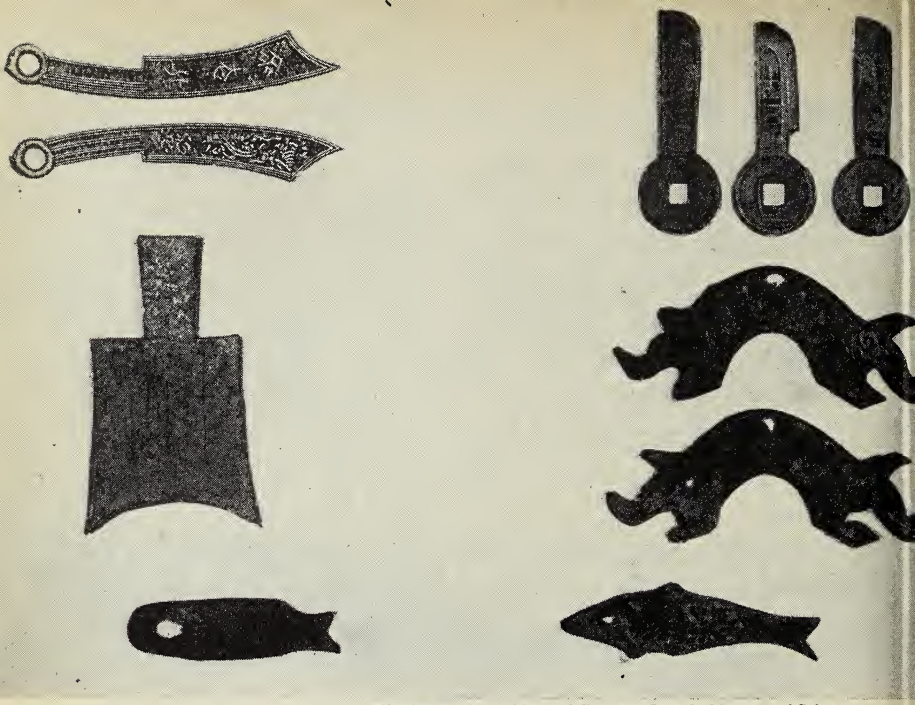
Courtesy Buffalo Museum of Science

The Greeks, who had used cattle for money, pounded copper flat and into the shape of an oxhide. Such a piece of copper, used in trading, had the value of an ox. When a merchant wanted to pass a coin in trading, he said, "This coin is worth an ox." That is, he valued the coin by a commodity. He did not say, "This ox is worth a coin." This fact shows that they thought of money only as something that *stood for* wealth. The money itself was not wealth, they thought.

Among other people, also, coins were made to represent a commodity. The early Chinese shaped metal to represent a shirt or a knife, and used it as coins in trading in place of real shirts and knives. As money came into more general use, it was found most convenient to make all coins round or square or oblong in shape.

At first, anyone who wished could make coins. Sometimes the money-makers did not make honest money, for some people in those days were crafty and greedy, just as some people are today. They made the copper strips weigh less than they should. They covered strips of dried mud with copper to make them look like solid metal bars. Sometimes they mixed copper or silver or gold with other metals which were of much less value.

Because the money-makers were not always honest, rulers or governments had to exercise some control over money-making. They tested the metals used. They weighed the metal pieces after they were made.

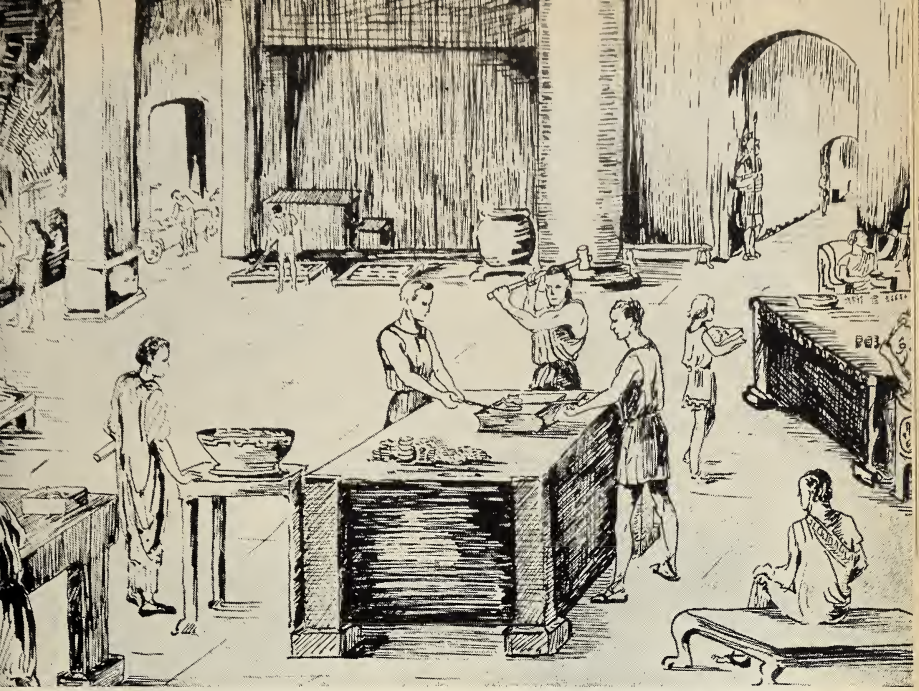


The Bettmann Archive and Courtesy Buffalo Museum of Science

ANCIENT CHINESE METAL MONEY

In the upper row are coins made to represent knives and keys. Below the knives is a coin, shaped like a spade. The other coins represent dragons and fish.

Finally, they found it a good plan to stamp each weighed and tested piece of metal with some picture which would tell people that the government considered the piece of money an honest one. When the making of money reached this stage, a piece of money became what we call a *coin*. Only stamped and tested pieces of money may be called coins. In this way, people became accustomed to the idea of the coinage of money by the government, and they found that government coins were safer to take in exchange than the money made by metalworkers.



Courtesy Buffalo Museum of Science

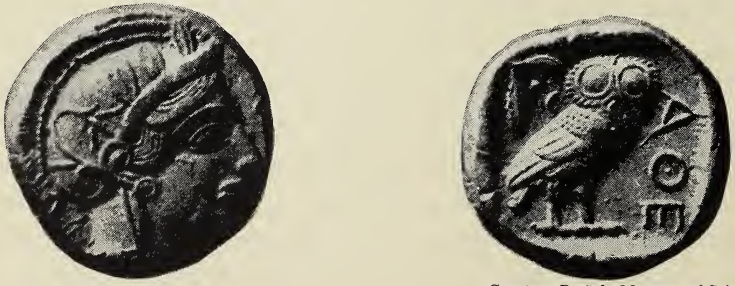
COINING MONEY IN ANCIENT GREECE

In the picture of this Greek mint, you can trace the steps in making metal coins — melting ore, pouring it into molds, and shaping, stamping, and weighing the coins.

After governments became interested in controlling coinage, many good ways of making coins were tried out. Copper and silver and gold were mixed with other metals to make them hard. A mixture of metals is called an *alloy*. These new alloys were made into coins. They were stamped with pictures of the things that the coins stood for — a fish or a turtle or a ship or some other commodity commonly traded. This was to remind the people that the coins took the place of the commodity which had first been used as a medium of exchange.

These ancient silver coins, which are stamped with pictures of things once used as mediums of exchange, were used in Greek cities in Italy in the sixth century B.C.

Two faces of a silver-turtle coin used in Aegina (Greece) as early as 550 B.C.



Courtesy Buffalo Museum of Science

The silver tetradrachma, whose two faces are shown above, was used in Athens (Greece) in the fifth century B.C.

Courtesy Buffalo Museum of Science

The first circular coin of Rome, dating from the fourth century B.C., shows the double-faced head of the god Janus on one side and the prow of a ship on the other.

Courtesy Buffalo Museum of Science

Two faces of a coin used in Egypt in the fourth century B.C.

Keystone View Company

The two faces of the Hebrew shekel, used in the second century B.C., are shown above. The shekel is mentioned in the Bible.

The coins used in the ancient civilizations did not altogether replace the use of commodities as money. For example, in ancient Greece, those people who lived some distance from the market liked to use coined money, for it was hard to drive an ox a long distance. Those, however, who lived near the market often preferred the live animal in exchange for the things they sold. So some traders continued to use the commodity as money while others liked better to use the coins.

The use of metal money was a great help in solving the problems of exchanging goods. And yet, it did not solve all the problems. Many groups of people continued the old system of barter for hundreds of years. Many groups of people never used metal coins at all, even though the coins were made by the government and used by kings and nobles.

Metal as Money. I. Why were copper pots so much in demand in the early days?

II. Explain why the obolus was better money than a copper pot; than an ox.

III. What distinguishes a coin from ordinary pieces of metal used as a medium of exchange?

IV. How does the government protect people today against dishonest money-making?

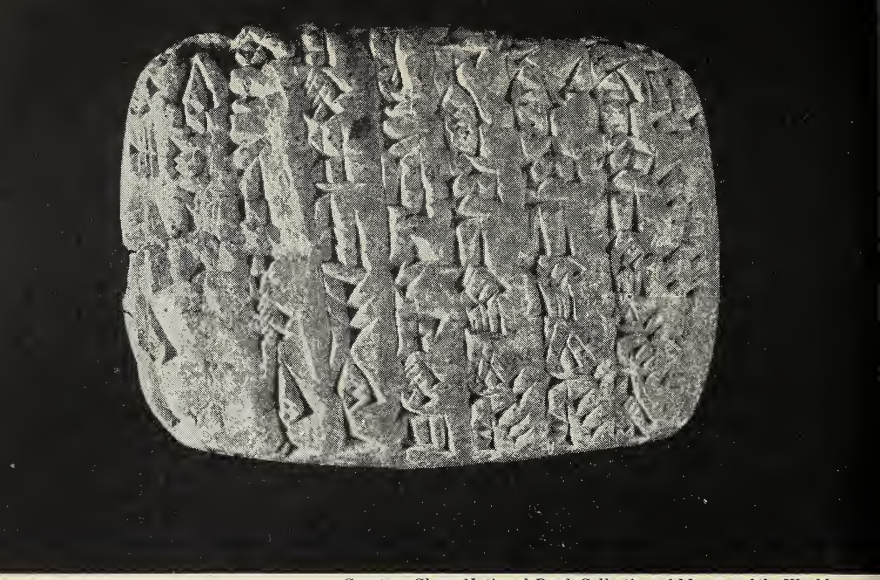
V. If there is a museum in your community, find out whether it has an exhibit of early coins. If it has, plan to visit it.

EARLY CREDIT MONEY

Thousands of centuries must have passed between the time when people satisfied their wants without trade, and the time when people learned to use metal or metal coins as their medium of exchange. Long before coins came into use, several great civilizations had grown up. One was the Babylonian civilization in the valley of the Tigris and Euphrates rivers in Asia. Another great civilization was the Egyptian civilization in the valley of the Nile River in Africa. Another was the Grecian civilization in southern Europe. Each of these groups of people had learned to weave fine cloths, make beautiful things from metals, build fine buildings, and carry on trade. In the important cities of Babylonia and Egypt and Greece were merchants who engaged in much buying and selling.

While the use of metal made the trading of goods easier, it was not always convenient to use it. A merchant might wish to buy large quantities of linen cloth. It would take a great deal of silver to pay for the cloth. The merchant might have to travel quite a distance to another city to buy the goods which he wanted. He would have to carry the silver for the purchase a long distance.

What could be done? Travel was difficult and slow. The bag of silver might be heavy and bulky. Robbers often lay in wait to attack the rich merchant and his servants as they traveled on the



Courtesy Chase National Bank Collection of Moneys of the World

A CLAY-TABLET DUE BILL

The tablet pictured above was used in Egypt. On it is written the record of a business transaction.

perilous roads across deserts and through narrow valleys. They would rob the merchant of his silver. Could not an easier way of exchanging goods be found?

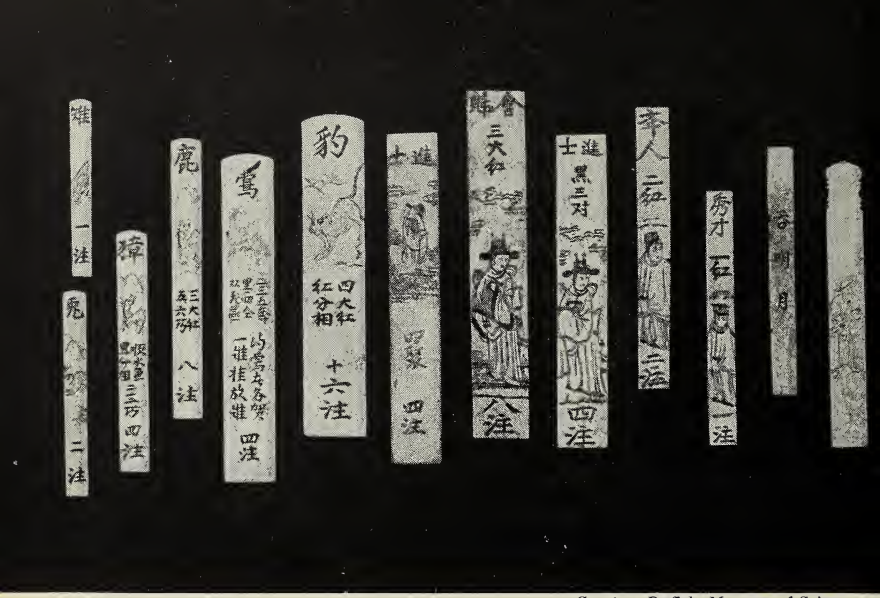
The people, as usual, found a way. A merchant who wanted to go to a distant city to buy cloth would write something in the soft clay of a small brick or clay tablet. What he wrote was a promise to pay a certain amount in silver to anyone bringing the tablet to him. Then he had the tablet baked so that the writing remained readable. When he started on his trip to buy cloth, he carried with him, not a heavy bag of metal, but a little clay tablet stowed safely away. In the next city, when

he found a merchant who would sell him cloth, he gave him the tablet in payment. Of course the tablet was not money. It was only a promise to pay money. Yet the clothseller was glad to accept the promise because he knew his buyer was a great merchant, a man who had much wealth, and an honest man.

What did the clothseller do with the clay tablet? One day he purchased some goods himself. Instead of paying for it in silver, he handed over the clay tablet as payment for his goods. Perhaps this third merchant passed the tablet to a fourth merchant. And so it passed on until it fell into the hands of a merchant who went down to the city where the very first merchant lived. While he was there, he went to that merchant, gave him back his tablet, and received in return as much silver as the writing on the tablet said it was worth.

Such buying without the passing of actual money is called *buying on credit.* Money such as the clay tablets used by early people is sometimes called *credit money.* In our business world today we do much buying and selling on credit; but it was several thousand years ago that the idea of buying on credit was first worked out.

In the early Mongolian civilization there was credit money. One kind of Mongolian money was a note printed on a square sheet cut from the skin of the stag. The skin was dried and smoothed until it was like paper. Such skin is called parchment.

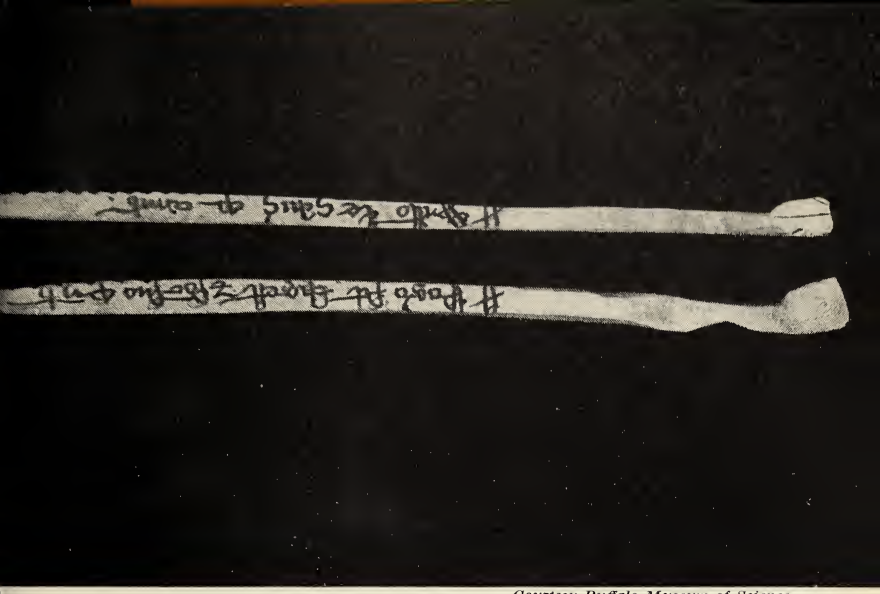


Courtesy Buffalo Museum of Science

IVORY MONEY OF CHINA

These interesting and artistically decorated strips of ivory are Chinese promissory notes; that is, written promises to pay. They were credit money issued by bankers, merchants, and other business houses.

As long as two thousand years ago the Mongolians used "promises to pay" written upon square sheets of parchment. Each note was accepted as good for a certain amount of money in the treasury. When Marco Polo visited the Great Khan, he came back and told his friends in Europe that he had seen the Mongolians using credit money made from the bark of the mulberry tree. The bark was stripped off the tree, dried, and smoothed. On it was stamped a certain value in metal and the seal of the Great Khan. This money was much like our paper money, as it was issued by the ruler. It was used by many, many people about seven hundred years ago.



Courtesy Buffalo Museum of Science

CREDIT MONEY OF EARLY ENGLAND

Sticks of wood like those above, known as *tallies*, were used in England from the twelfth to the early part of the nineteenth century. The use of the tallies was abolished by George III, and the last tallies were destroyed in 1834.

In England, during the Middle Ages, there was an interesting kind of credit money. A man of wealth might deposit a certain amount of coin in the Government treasury. The amount he deposited was marked off in notches on a strip of wood. Then the strip of wood was split in two, lengthwise, down the middle through the notches. One half was kept by the treasury for its record, and the other half was given to the depositor as his record. Later, when the depositor of the money made a purchase, he might use the notched stick as money. The person who received the notched stick might himself take it to the Government and demand the

money, or he might pass it on to someone else in exchange for goods.

These interesting ways of solving one of the important money problems of earlier people — the problem of how to avoid carrying around bulky money — were steppingstones to some of the things we do today. The idea of the paper money which we use today and of the check books which we carry about in place of money had its beginning in the practices worked out by these early people many hundreds of years ago.

Using Credit Money. I. Mention some ways in which we use credit money today. What do we use to take the place of the clay tablet?

II. Would a cloth merchant have been willing to accept a clay tablet as money from a man whom he knew nothing about? Why or why not? Explain your answer in a written paragraph.

III. Have you ever bought anything on credit? If you have, explain why you were allowed to do so.

Living Long Ago. I. Describe in three paragraphs the kind of credit money used by the Egyptians, the Mongolians, and the English people in the Middle Ages. Which country used credit money most nearly like our credit money of today?

II. What were some of the dangers of traveling in early days? Explain why people often used caravans for traveling long distances.

IV. CIVILIZATIONS USING LITTLE MONEY

Even after money had been invented, it was not always used. Some great civilizations which grew up in the past managed very well with little or no money. Indeed, some groups of people living not many hundreds of years ago managed with very little money. How did such people satisfy their wants?

THE HOUSEHOLD SYSTEM OF EGYPT

Because we live in a country where money is necessary to the plan of living, we are likely to think there has never been any other kind of civilization. But that is a mistake. There have been great civilizations in which people carried on their activities for years and years without even seeing a piece of money. And they lived well, too. Some people call such civilizations *moneyless*.

We must not make the mistake of thinking that moneyless civilizations were either poor or primitive. Some of the great civilizations of the world have made wonderful progress and yet have managed to carry on their business without much use of money.

Neither must we make the mistake of thinking that the people of moneyless civilizations were ignorant of money. Some of those civilizations used money

for a time and then abandoned its general use. Some of the civilizations had money to use, but it was used by only a few of the people. In such a civilization the great mass of the people did not depend on money to satisfy their wants.

One of the first great civilizations of the world, the Egyptian, grew up in northern Africa along the banks of the Nile River. The Egyptians were among the first people to find out how to cultivate the land and raise plants for food. They were among the first people to learn how to control a great river and to use its flood waters for irrigating and fertilizing the soil. They were among the first to cut stone and use it for building. They were among the first to make boats and to sail to other lands in order to bring home the things which they could not provide for themselves.

Having accomplished these things, the Egyptians were able to live better than most other groups of people who were living at that time. Egyptian craftsmen made beautiful linen cloth for the clothing of the people. They built wonderful buildings — homes for the wealthy, temples, tombs for their Pharaohs. The priests learned to write. They learned to measure time and distance and weight and quantity. They learned some of the secrets of the stars. Craftsmen made beautiful glassware and pottery and jewelry. They made tools and utensils and weapons. The Egyptians became a highly civilized group of people.

Strange to say, the Egyptians built up this wonderful civilization without much use of coined money. How were they able to accomplish this?

Much of the food of the Egyptians was raised on the farms of the nobles. The farms of the nobles were very large, and the work of farming was carried on by hired officials and by peasants. Some of the peasants tilled the land. Some irrigated the soil. Some tended the flocks and herds. Some harvested the crops. Some made bread for all of the others to eat. Some made wine, and some cured meat. Some spun flax, and some wove the thread into cloth. Some made tools or utensils or repaired the buildings. Some made furniture. Some workers cooked the food, and still other workers kept the household clean and comfortable.

Money was not needed in running the household of one of these great farms. There was no need for buying anything except perhaps salt. The noble might buy a few luxuries for himself and his own family now and then. But nearly every necessity of the noble and his family was raised or made on the farm. Everything that the workers needed was also made on the farm.

Satisfying the wants of the nobles and their workers did not depend upon buying and selling. Each worker was a member of the household. Each worker had the responsibility for one task. In return, he received a living. The things which all of them produced were divided among the group.

Hudson Historical Bureau

A WEIGHING EXCHANGE IN ANCIENT GREECE

The interesting picture above is taken from an ancient Greek vase. At the left, holding a scepter, is a king of Cyrene. At the scales stands an officer of the king. Men are bringing in sacks of silphium, a medicinal plant used as a medium of exchange. The sacks are weighed and their weights recorded. The lower part of the picture shows other workers storing the sacks in a cellar storeroom. Later, when the Greeks made crude coins, some of the coins were stamped with an imprint of a silphium plant.

Each member of the household took his share. Each worker produced something for the others to use.

Such a method of satisfying wants is called the *household system.* Large groups of people, masters and slaves, made up the household. Nearly everyone worked. Everyone used the things produced. What the household did not need was exchanged in the markets for luxuries for the family of the noble.

There were some small farms in Egypt. They were tilled by serfs who were responsible directly to the Pharaoh. They paid their taxes to the Pharaoh in grain or cloth or fruit or wine or anything they produced. These small farmers had very little to trade after they had paid their taxes and fed and clothed the members of the family. If they did have some commodity left over, they bartered it for necessities that they could not produce on their tiny farms.

Many of the people of the Egyptian cities or towns worked as craftsmen or scribes or soldiers or sailors or fishermen. A cobbler who made sandals exchanged them for fish or grain or tools. A carpenter exchanged chairs for sandals or meat or bowls or cloth. A weaver exchanged cloth for yarn or grain or chairs. The common people used no coined money; only priests, nobles, and the Pharaohs used money. Trade was carried on largely by the actual exchange of goods.

Nobles, priests, and Pharaohs did not work. But they had commodities to exchange, however, for they

The Bettmann Archive

BARTER IN ANCIENT EGYPT

These copies of paintings in ancient tombs tell us a story of Egyptian barter. In the upper left picture, a fish merchant sitting before his basket of fish is bargaining with a woman who carries her objects for barter in a box. At the upper right, a seller of cakes is exchanging one cake for a chain or collar. Can you interpret the other pictures?

had whatever their slaves or serfs produced for them. They also exchanged gold or copper rings for the luxuries they wished to buy. These rings were exchanged among the nobles or were used in trading with strangers.

What you have read of the household system of Egypt was true of other ancient civilizations. It was true of the great civilization of Babylonia. It was true of the Phoenician civilization. It was true of Crete and of China. It was true, to a large extent, of the early Greek civilization.

The Household System of Egypt. I. Choose one of the following topics and read to find out about it in order to make a report to the class. Try to show in your report what a great civilization the Egyptians had.

The Egyptians as great builders.
The Egyptians as great farmers.
The Egyptians as great craftsmen.

II. Explain what is meant by the statement on page 473, "We must not make the mistake of thinking that moneyless civilizations were either poor or primitive." Give illustrations to show the statement is correct.

III. Write a paragraph telling why you would or would not have liked to belong to an Egyptian household.

IV. Did the Egyptians produce goods largely for sale or for their own consumption?

V. Explain why the wheat grown on an Egyptian farm was wealth.

VI. Were there any service workers in an Egyptian household? Give some illustrations to prove your answer.

VII. Below are some words which you will find used in stories about the Egyptians. If you do not know what they mean, look them up in the dictionary. Write out an explanation of each term.

Pharaoh	sphinx	irrigation	papyrus
pyramid	nobles	Nilometer	peasants

VIII. Write a paragraph explaining some important differences between the ways in which the Egyptians lived and the ways in which we live in America today.

THE HOUSEHOLD SYSTEM OF THE MIDDLE AGES

The Middle Ages is that period in the history of Europe which followed the breaking up of the great Roman Empire. It was a period of danger and suffering and terror. The strong, protective government of Rome was no longer at hand to settle the quarrels of the people and to keep order. Rough barbarians swarmed down upon Europe, and everyone was afraid for his life and for his property.

The Roman Empire, which had extended over much of central and western Europe, had been a money civilization. People bought their food with money. They bought their clothing with money. They paid their rent in money. The very lives of the people depended upon having money to pay for the things they needed. It was the only way that most of the people could satisfy their wants.

But after the Roman Empire had fallen from power and many towns and cities had been burned, trade almost ceased. There was little to buy, and there were few markets in which to buy. Merchants were afraid to travel, for robbers were everywhere. Gradually money became unimportant, and in time, it was little used.

During those troublous times the tribes of people who were friendly clung together. It was the only way they could feel safe. People clustered in groups, and some of the members of each group spent their

Hudson Historical Bureau

SERFS REAPING GRAIN

time protecting the others. The rest of the group produced a living in return for protection.

The groups of people needed leaders in those times of danger. Gradually leaders arose — kings and powerful lords and knights. The king took possession of large areas of land and ruled the people living upon the land. The king had a following of lords and knights who were pledged to help defend the king in time of battle. As a reward each lord was given control of a part of the land, and his followers were compelled to fight for him and for the king. The peasants on his land tilled the soil and performed all the work necessary to satisfy the wants of the noble and his family and themselves. These leaders needed the common people to do the work of cultivating the land. The common people needed the powerful rulers to protect them from enemies.

Gradually the people under one lord became one household. The lords and knights were the protectors. The people were the workers. This system

Hudson Historical Bureau

A SWORD SHARPENER AND AN ARMORER OF MEDIEVAL TIMES

of living was called the *feudal system.* Each lord with his family, his knights, his pages, and his servants lived in a large stone castle. Part of the members of the household did not live in the castle. Serfs who tilled the land lived close together in a little village near the lord's castle. When the castle was attacked, as it often was, the people from the village drove their animals within the castle walls and remained there until the danger was over.

The lord's estate was large and complete in many ways. It had its grain fields. It had its pastures. It had stacks of hay for the livestock and straw for bedding. It had granaries for storing grain and storehouses well supplied with smoked

Hudson Historical Bureau

A WHEELWRIGHT AND A COBBLER'S SHOP OF MEDIEVAL TIMES

meats, vegetables, and flour. It had its sheepfolds and cattle sheds, its slaughter houses and gristmills. It had its smithy where the horses were shod and where tools and weapons were made and repaired. It had its wine presses and its great kitchens and bakeries. It had large flocks of sheep and fowls and herds of cattle and pigs. The lord owned many horses for the use of his knights and oxen for work on the farm. Woodlands furnished fuel for the use of all the household. Lights also came from the woodlands, for most of the people used pine knots in place of candles. Berries grew wild in the woodlands, and wild game for the lord's table was plentiful.

The homes of the villagers were built close together inside a fence. The houses were built of wood and had thatched roofs. They were mean little hovels, ugly and dark. The villagers had little furniture — usually only a few stools and a table. Perhaps a bunk, fastened against the wall, gave them a place to sleep. More often the people slept on straw on the floor. A slab of stone placed in the middle of the floor was the fireplace. Above the slab of stone a hole for letting out the smoke from the fire was cut in the roof.

The villagers seldom left the village except to go to the fields. They made everything they used in their homes — furniture, utensils, tools, clothing. The men raised grain on their little strips of land and took it to the lord's mill to be ground into flour. The blacksmith made all sorts of things — plows, spades, knives, and swords. All the clothing was made at home by the women who spun the thread, wove it into cloth, and made the cloth into garments. The women cooked the coarse food, baked bread, and milked cows. Often they went out into the fields to help the men.

Each member of the household was expected to do a particular piece of work. Shepherd, swineherd, cowherd, miller, blacksmith, cobbler, armorer, bailiff — each had his own job. The bailiff was the man who had charge of all the other workers. He also had charge of the entire household, the *manor*, as it was called.

The Bettmann Archive

A MARKET PLACE IN A MEDIEVAL TOWN

Lords and ladies visit the stalls of tradesmen and peasants to buy their wares.

The greatest number of workers cultivated the soil. They usually spent three or four days of each week working on the lord's land. The rest of the time they tilled the strips of land which they rented from the lord. The serfs paid for the use of the land, but not in money. They paid in work and in the products they raised. At Christmas time they had to give the lord chickens and geese, and at Easter time they had to give him eggs.

A medieval manor was a self-supporting household. It furnished everything needed but salt. There was little exchange among the villagers. There was little buying and selling even among the lords. The people raised what they ate. Their flocks of sheep furnished wool for clothing. The forests furnished nearly everything else they used. Money was needed only to buy armor for the knights, to provide ransom in case of capture by an enemy, to buy weapons, salt, and the few luxuries which the lords might buy at the fairs held once or twice a year.

However, there was some money among the various groups of people in Europe. Indeed, there were so many kinds of coins that it was hard to trade. Coins from England, from Spain, from France! Coins from Genoa, from Florence, from Venice! Coins of silver, of gold, and of copper!

Moneylenders had money. Lords had money. Kings had money. Often lords and kings borrowed money for carrying on their wars. But money

Hudson Historical Bureau

A MEDIEVAL FAIR

Stalls shown in the center of the picture offer wares for sale, while sports and amusements take place around them.

was used for only certain purposes. It was not needed for the necessities of living. Many, many people during the Middle Ages were born, grew up, and died without even having seen a coin.

Under such a system of living, there was little chance of bettering oneself. The existence of the serf was wretched. His food was coarse, and his life was one of wearisome work.

Gradually, however, the people of Europe regained the things they had lost at the time that the barbarians had overrun the Roman Empire. They rebuilt the cities. They improved the roads and protected them. Trade once more was established.

The old system of barter began to disappear. The serfs began to take the goods they wished to sell to market towns near by. As they began to receive money for their goods, they began to pay their taxes and their rent to the lords in money. That made them more independent. The lords were glad to get money, too. Gradually, the old system of the control of nobles over peasants died out.

So money again came into use. Today, Europe has a money civilization just as America has. People live by buying and selling. People satisfy their wants by earning and spending money.

Living in the Middle Ages. I. Explain in what ways the households of the Middle Ages were like the households of the Egyptian farmers.

II. Explain how the household system of the Middle Ages began and the circumstances which made it develop.

III. State clearly in what ways it can be said that the people of the Middle Ages lived in a moneyless civilization although coins of different countries were in use.

IV. Were most goods produced for sale or for consumption during the Middle Ages?

V. Tell in what ways the workers of the Middle Ages differed from workers today.

VI. Write a statement explaining what is meant by the household system. Tell in what ways you think the household system was good and in what ways you think it was not good. Would it be a good system for us to use today? Why?

THE HOUSEHOLD SYSTEM OF COLONIAL TIMES

By the time that people of Europe began to cross the Atlantic Ocean to build their homes in America, money was in common use in the countries of Europe. The feudal system of the Middle Ages had died out, and the separate nations of Europe had organized stronger central governments.

So the people who came to America as colonists knew about money. They had used money in their European homes. Most of them probably brought some of the money of their native countries with them to America. But when they reached the shores of America, they found little use for coins. There were no markets in the wilderness called America. The Indians did not know anything about European money. There was little food in this new land. With all the money in the world in their possession the colonists could not have bought enough food in America to keep them from starving.

What would keep them from starving? Work. The settlers had to work to get food. They had to sow seeds and raise grain. They had to plant gardens and raise vegetables. But before they could have gardens and fields, they had to clear the land. There was nobody who could be hired to do this work. Men and women had to work to get their food and clothing and to provide roofs to cover their heads. Even the children had to do their share of the work.

And so again we find a group of people who could get along better without money than with it — another moneyless civilization.

The colonists did just as the people of the Middle Ages did. They adopted the household method of producing the things they needed. But the households of the colonists were very different from the manors of Europe. They were much smaller. Each colonial household consisted of only one small family — father, mother, and children. Many of the colonists did not even have servants at first. Everything that was done had to be done by the members of the family.

But even if the households of the colonists were much smaller than the manor households of the Middle Ages, they were not different in kind. The members of the household had the same purposes — that of producing the necessities of living and that of protecting its members. There was division of work among the members of the household, and everyone had to do his share. There was the same dependence upon the soil and upon animals for the satisfaction of wants. There was the same dependence upon the forests for houses, fuel, lights, weapons, tools, and utensils. There was the same sharing of the things which were produced. And there was the same need for careful planning and the leadership of one person — usually the father.

The first white people who came to America were without houses to live in. They had to build them.

The forests were full of beautiful tall trees — enough to make lumber for thousands and thousands of homes. Yet lumber could not be bought. There were no sawmills and few saws with which to cut down trees and make boards. There were no nails with which to fasten the wood together.

There was plenty of clay and limestone. There was a great deal of granite and marble and sandstone — enough to make all the houses they needed. And yet the colonists had no way of cutting stones nor of making bricks.

So housebuilding was not very elaborate at first. All the men could do was to build cabins as quickly as possible from the logs of trees which they hewed down. Some even depended upon bark wigwams, such as the Indians built, or slept in caves dug in the sides of hills.

The crude homes had little furniture. Some of the settlers had brought chests and feather beds and copper kettles and spinning wheels with them from Europe. But some did not bring house furnishings. What could they use?

They made their furniture from wood. They fastened the posts together with wooden pegs. The furniture was rude and uncomfortable, but it was better than nothing. Homemade benches served for chairs. Bunks served for beds. Gourds served for drinking cups. Everything that people wanted had to be made with their hands and with the few tools they had brought from Europe.

After the settlers had built their crude homes, they cleared the land and planted crops. They harvested crops by hand and stored the grain in homemade containers. They fished and hunted the wild animals for meat. They gathered wild fruits and wild plants of various kinds. The colonists did not always have enough to eat. What they did have was hard to get. It was a case of work or starve, for there was no way of buying the necessities of life.

The women raised flax and spun the fibers into thread for their looms. Every minute they could spare from other duties was spent at the spinning wheels. A child learned to spin as soon as he was able to make the wheel turn. Every yard of thread was precious. The women wove the thread into cloth on their wooden looms. They dyed it with stain from wild berries. They made the garments by hand. The clothing they made was coarse and heavy. It was hard to make, and making it took a great deal of time. But it saved them from freezing. These early settlers could not have had clothing if they had not been able and willing to make it themselves. There were no stores in which to buy clothing.

The women made curtains for their windows and blankets for their beds. They knitted stockings for their children, for their husbands, and for themselves. The men tanned the leather for shoes and made them as well as they could.

At first, the colonists gathered pine knots to use for lighting their houses. Later, they made candles from the wax of the bayberry, a plant that grew in New England. They made fires by striking together flint and steel and cooked over an open fire in a fireplace. They served their food on wooden trenchers and ate with wooden spoons carved from soft pine.

Each household was self-supporting. It was independent of every other household except for protection from the Indians and from other dangers. Its members were not independent, however. Each depended upon the family group for support. No one member could get along well without the others.

When the early colonists wanted articles which they could not make within their own households, they had to secure them from England. Ship captains brought to the New World fine furniture, dishes, carpets, and luxuries to trade to such colonists as wanted them. In the South, they bartered these articles for tobacco which the planters had rolled down to the wharves in casks. In the North, they traded them for lumber and furs and other articles which the colonists had in abundance and which the countries of the Old World needed. Some barter was also carried on among household groups.

As time went on, more and more people came from Europe to America. Some of the men who came over were trained to do some special kind of work. So they set to work in the New World as weavers, or carpenters, or shipbuilders, selling their

services to other people. But they did not sell the services for money, for there was no money. They bartered their services for food, for shoes, for clothing, or for whatever they needed.

When the colonists found it possible to buy cloth from weavers, shoes from cobblers, and food from merchants, they began to feel the need for money. But they had none — at least, they had very little. The few coins to be found were the coins of foreign countries. So they used commodities for money. Beaver skins became money, for everyone was willing to take beaver skins. They could be sold in England readily for any products the colonists wanted. The pelts of other animals became money. Tobacco, also, was used as money. It was accepted in all the colonies and was in great demand in the countries of Europe.

The Indians brought furs to the settlements of the colonists when they learned that the colonists prized furs. They were glad to barter their furs for bright-colored beads, knives, hatchets, cheap jewelry, or other trinkets. The settlers even learned to take wampum, the Indians' money, in exchange for things which the Indians wanted, and in some settlements Indian wampum was passed between white people as money.

On the opposite page is a list of prices printed in 1703. Such a list was put up in a colonial trading post to show the value in beaver skins of different kinds of goods.

July 14th. 1703.

Prices of Goods

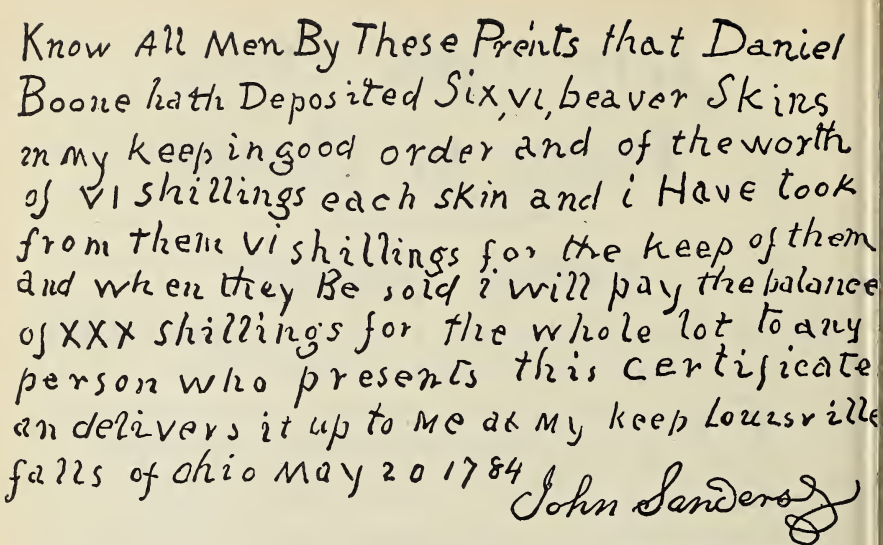
Supplyed to the

Eastern Indians,

By the several Truckmasters ; and of the Peltry received by the Truckmasters of the said *Indians.*

One yard Broad Cloth, *three* Beaver skins, *in season.*
One yard & half Gingerline, *one* Beaver skin, *in season*
One yard Red or Blew Kersey, *two* Beaver skins, *in season.*
One yard good Duffels, *one* Beaver skin, *in season.*
One yard & half broad fine Cotton, *one* Beaver skin, *in season*
Two yards of Cotton, *one* Beaver skin, *in season.*
One yard & half of half thicks, *one* Beaver skin, *in season.*
Five Pecks Indian Corn, *one* Beaver skin, *in season*
Five Pecks Indian Meal, *one* Beaver skin, *in season.*
Four Pecks Pease, *one* Beaver skin, *in season.*
Two Pints of Powder, *one* Beaver skin, *in season.*
One Pint of Shot, *one* Beaver skin, *in season.*
Six Fathom of Tobacco, *one* Beaver skin, *in season.*
Forty Biskets, *one* Beaver skin, *in season.*
Ten Pound of Pork, *one* Beaver skin, *in season.*
Six Knives, *one* Beaver skin, *in season.*
Six Combes, *one* Beaver skin, *in season.*
Twenty Scaines Thread, *one* Beaver skin, *in season.*
One Hat, *two* Beaver skins, *in season.*
One Hat with Hatband, *three* Beaver skins, *in season.*
Two Pound of large Kettles, *one* Beaver skin, *in season.*
One Pound & half of small Kettles, *one* Beaver skin, *in season*
One Shirt, *one* Beaver skin, *in season.*
One Shirt with Ruffels, *two* Beaver skins, *in season.*
Two Small Axes, *one* Beaver skin, *in season.*
Two Small Hoes, *one* Beaver skin, *in season.*
Three Dozen middling Hooks, *one* Beaver skin, *in season.*
One Sword Blade, *one* & *half* Beaver skin, *in season.*

Hudson Historical Bureau


Know All Men By These Prents that Daniel
Boone hath Deposited Six, VI, beaver Skins
in my keep in good order and of the worth
of VI shillings each skin and i Have took
from them VI shillings for the keep of them
and when they Be sold i will pay the balance
of XXX shillings for the whole lot to any
person who presents this certificate
an delivers it up to Me at My keep Louisville
falls of ohio May 20 1784 John Sanders

Hudson Historical Bureau

A COLONIAL NOTE

The quaint old note reproduced above took the place of the clay tablet that was used in ancient civilizations.

So, in the beginning, the early American colonists had what might be called a moneyless civilization. Money was not necessary to their way of living, for they produced goods for their own use and not for sale. But, in time, the population of the colonies grew large enough to make trade profitable. When this time came, the colonists felt the need of money. At first, they used any kind of money they could get — Spanish coins, English coins, French and Dutch and Swedish coins. In time, however, the people of the colonies needed money so badly that they learned to coin money for themselves. One of the earliest coins was the pine-tree shilling which was minted in Boston in 1652.

Hudson Historical Bureau and Courtesy Buffalo Museum of Science

COLONIAL MONEY

Indian wampum and beaver skins were as common as the pine-tree shilling and the Spanish milled dollar in colonial trade.

Exchange in the Colonies of America. I. Explain why the first people to settle in America could not supply their wants by the use of money.

II. Study the story of colonial times (see pages 489–497), to find the differences between the way the people lived then and the way we live today. Discuss these differences. You might consider such questions as these:

1. Could a colonial family be more independent of other people than a family of today?
2. Was a member of a colonial family more dependent upon the rest of the family than a member of a family today?
3. Were the early colonists as dependent upon money as we are?
4. Who produced the goods for consumption in colonial days? Who produces such goods now?
5. Were goods produced for sale and profit in colonial days? Are they now?

III. Find a story which tells how the white people and the Indians traded. Perhaps you can tell the story of the purchase of Manhattan Island.

Things to Read. The following books will tell you some things about different ways of living in the moneyless civilizations:

America's Roots in the Past by Daniel J. Beeby and Dorothea Beeby

Home Life in Colonial Days by Mrs. Alice (Morse) Earle

Medieval Days and Ways by Gertrude Hartman

V. MONEY AND TRADE TODAY

For thousands of years men have attempted to satisfy their wants through the exchange of goods. During this time they have searched constantly for better ways of carrying on trade. They have invented money as a tool of trade. Trade customs have been built up. From these trade customs, institutions of exchange have developed. What are some of the more important institutions of exchange? What services do these institutions perform?

MONEY A USEFUL TOOL

Is there no way of satisfying human wants today except by using money? Could we not trade goods by barter as people did for so many years?

Certainly people could go back to a barter system of exchanging goods if they wished to do so. But under the barter system we could not enjoy the kind of civilization we have today. Moneyless civilizations and money civilizations are quite different.

Imagine, if you can, a farmer of our times bringing in a bushel of potatoes to trade for some postage stamps. Try to think of a laundryman trading so many hours of laundry service for tickets to a motion picture. Imagine a restaurant keeper exchanging hot

meals for a ride on the train. Imagine yourself paying for a ride on a streetcar or bus with an apple. Even if you could do so, imagine what you or your father might have to do in order to get apples for carfare. Would your father work for the orchard owner and be paid in apples? Or would you shine the shoes of the orchard keeper and be paid in apples?

You would not have to keep on imagining very long to discover that the barter system would not work in a civilization such as we have in our country today. The early hunters, the shepherd tribes, the farmers of the Nile Valley, and even the manor households of the lords of the Middle Ages were much smaller groups of people than are found in our countries of today. The people in these earlier groups lived simpler lives. They needed food, but their foods were few. They needed clothing, but they wore the same simple garments over and over again. They needed homes, but their homes were largely tents or huts. They seldom traveled farther than they could walk. Few of them went to places of amusement. There were no schools such as we know, and few people had education as we know it. There were no lighting systems or heating systems, no telephones, and no transportation systems. Probably most of the people in those earlier civilizations lived for days without even having to barter for something they needed and did not produce themselves.

You have read that in colonial days in our country the early settlers had no use for money. They worked

to satisfy their own wants; and when they wanted something which they could not produce, they traded something of what they had produced for the goods which they needed. But the time came when, even for them, barter would not satisfy the needs of trading. The thrifty colonists produced more and more goods. One colony produced goods which another had need of. A colony produced enough lumber or tobacco to load upon ships and send to England, and there were goods produced in England which the colonists wanted. The amount of goods produced and the amount of trading to be done became too great to be handled by the barter system. People grew to have too many different kinds of wants. Too many products were made to permit easy trading by barter. When that time came, tradesmen demanded a new tool for trading. They demanded money — not the money which consisted of desirable commodities, such as beaver skins or oxen, and not even metal pots or bars; they demanded coined money.

Why is trade today so important and so much more difficult than it once was? Scientists and inventors and producers of all kinds have made a great many things that have become desirable to people. So the wants of people have increased. Instead of pine knots or candles we want electric lights. Instead of tents or crude huts we want comfortable homes, comfortably heated and furnished. Besides bread and meat and a little fruit we want many good things to eat. We want so many things that it takes a great

many producers and merchants and traders to satisfy our wants. Trade — buying and selling — is so great a part of life today that we cannot imagine living without trade.

And what makes coins and paper money necessary tools of our heavy trade today?

In the first place, coined money is a convenient medium of exchange. Paper money and gold, silver, or copper coins are small and are easily carried about and passed from hand to hand. Coins or paper money can be made in different values, from just a cent or a part of a cent in value, to a single coin or bill of much greater value. It is easy to make a trade — to buy something — when one can reach into one's pocket and take out a piece of money of just the right value, or put several pieces together to make the right value. It is convenient, too, to make change with coined money.

Money is also an easy measuring stick of value. Just as we need to measure the length or the weight of an article in buying or selling, we need to measure value. In the United States we measure the value of anything in terms of the *dollar*. In England the standard of value is the *pound*. In Germany it is the *mark*, and in France it is the *franc*.

The dollar helps us calculate the cost of living. It helps us make comparisons. We say, "This suit costs thirty-five dollars, while the other one costs only thirty dollars." Putting it in this way helps us make a choice between the two suits. So our prices

are stated in terms of money. Price and value are not the same thing, although they are sometimes used in the same way. The value of an article may be higher or lower than the price. But the price is the amount of money the seller asks for merchandise. Using the dollar as a standard of value makes price setting, buying, and selling very easy.

The use of coined money also makes it easier to save for the future. There are many reasons for saving money. Some save money so that they will have it for use when they become too ill or too old to earn a living. Some save money because of some future expense, such as educating their children, which they know they will have to meet. And some save so that they can buy something which they wish to own.

A man may want to build a house. But he does not have money enough now to pay for all the materials and the labor. What can he do? Can he buy the materials, a little at a time, until he has enough to build the house? What a job it would be to buy his materials in small lots and store them! Imagine him buying nails and putting them away; buying windows and storing them; buying lumber or bricks or cement to have on hand when he was ready to build his house. By that time some of his materials might be useless. Metals might have rusted. Boards might have warped. Bathroom fixtures might be out of style. Besides, what a job it would be to store such large things!

Of course people do not save in that way. They put a part of their earnings into the bank each month until they have enough money in the bank to buy a house or an automobile or to support them when they are too old to work. One advantage of the kind of money which we use today is that we can save it until we need to use it. The commodities, such as oxen, wheat, skins, and other articles which were used as money in the past, could not be kept over long periods of time.

Money has still another advantage as a tool of business. For instance, a man may not care to wait until he has saved enough money to pay for building a house. What can he do? If he is a man with a reputation for honesty, perhaps a bank or a friend will lend him money; or, possibly, he may arrange for a building company to build him a house. The building company promises to build the kind of house the man wishes. The man promises to pay the building company a certain sum of money each month until he has paid all that it cost to build the house. The man would also have to pay the building company an additional sum of money for the privilege of borrowing the money. Money which is paid for the use of money is called *interest.*

The man and the building company both benefit by this transaction. The man lives in his house while he earns money to pay what he owes. The building company will receive all it had lent, and also the interest on the money loaned.

Because money may be borrowed when it is needed and repaid at a future time, we say that money is a standard of measurement for future payments. People borrow a certain number of dollars. At a later date they pay back to the lender a certain number of dollars. A man knows how much money he owes, because he knows how much he borrowed.

In our enormous trade today, we need (1) a convenient medium for exchanging goods, (2) a way of stating the value of articles to be bought and sold, (3) a means of saving for future use, and (4) some way of expressing what people owe and what they are to pay at some future time. The use of coined money makes it possible to exchange goods, set prices, save money, and keep accounts of business transactions, such as borrowing and lending. Money of the kind we use today is the most useful tool which has been discovered for carrying on the exchange of goods.

Money a Useful Tool. I. Write a paragraph explaining what a person would have to do to borrow if there were no money in circulation. Describe the difficulties.

II. Imagine the difficulties of saving to get a house if there were no money. Describe what might happen.

INSTITUTIONS FOR BUYING AND SELLING

What a bother it would be to us if we had to go to the producer to get the many kinds of goods we want to buy. We would have to go to the farmer to get eggs and vegetables and milk. We would have to go

to the shoe factory to get shoes, to the textile mills to get cloth for clothing, to the hat factory for hats, to the flour mill for flour. We would spend so much time running about from one producer to another that we would have little time left to earn money to pay for the things we needed to buy.

Fortunately we do not have to do this. We have stores, shops, and markets. They are institutions which carry on the business of buying and selling — institutions for exchanging goods.

Ever since you can remember, you have been visiting stores and buying things which you need. You have gone to clothing stores to get your clothing, to food stores and markets for your food, to candy stores for your candy, and to toy stores for toys. You have gone with your father to the filling station to buy gasoline for the car. You have gone to the popcorn wagon for popcorn. You have gone around the corner to the baker's shop to get bread for your mother and across the street to get ice cream at the drugstore.

At almost any time of day that you chose to visit these stores, you have found men or women busy waiting on customers — showing them goods, wrapping packages, making change. Salespeople busy selling, selling, selling! Customers busy buying, buying, buying! There is no end to the exchange of goods. People never seem to finish buying goods to satisfy their wants.

The stores and shops and markets where people go to buy goods to satisfy their wants are called *retail*

establishments. Retail merchants sell usually to the person who uses the goods; that is, to the *last buyer*. We call the last buyer the consumer.

Consumers demand a great many extra services of the retail store. They demand that the store be placed at a point convenient for them to shop. Often this makes rent higher than it would be if the store could be placed in a less favorable location. Many consumers demand that goods be displayed attractively. Some of them demand that they have the privilege of charge accounts, that they have delivery service, and that they have instant attention when they go to the store to buy. All of these extra services cost money. The retail merchant adds the cost of these extra services to the price which he asks for his goods. The consumer has to pay for all the services he asks for. But many consumers do not realize this. They think that they are getting all of these things free.

Retail merchants have tried to cut down the cost of operating stores. They have developed many new kinds of retail stores.

The chain store is one kind of retail store planned to cut down operating costs. The companies owning chain stores buy goods in large quantities and therefore at lower prices. They buy carloads of food at a time, storing it in their own warehouses and sending supplies to each of their stores as they are needed. Some of the chain stores have their own processing plants. They prepare canned goods. They package

coffee and tea for sale. Many of the chain stores do not allow charge accounts and do not deliver goods. By so doing, they save some of the heavy cost of operating a store. Some of them expect the customers to wait upon themselves. By saving expense, they are able to sell their goods at lower prices. Many other storekeepers have used similar plans to enable them to operate their stores at less cost.

The mail-order house is another kind of store which has attempted to buy and to sell goods at less cost. A mail-order house advertises its goods by catalogues mailed out to consumers. Thousands of different articles of all prices and all kinds are advertised. The catalogues describe the goods for sale, thus taking the place of salesmen. Mail-order houses buy in large quantities at cheaper prices. They buy goods which are produced in many cases from standard patterns and in large quantities. Consumers order and receive the goods by mail.

There are some people who object to chain stores. Among other things, these people say that such stores are not owned and operated by local people and that the profits are sent away to other localities, thus taking the money out of local circulation.

Department stores are a very convenient type of retail store. A department store may be a combination of a clothing store, a drugstore, a bookstore, a shoe store, a grocery store, a furniture store, a toyshop, a gift shop, a hardware shop, an electric shop, a sports shop, a music store, a millinery shop, and a

luggage shop. A customer can fill almost all his needs in one department store.

Perhaps you have heard people say that the prices which they have to pay the retail store are too high. Consumers often think they are paying more for certain articles than is necessary. This may be true; and yet there is another side to this problem of price which we should think about.

Most articles which the retail merchant sells to the consumer have been bought and sold many times before they reach the retail merchant. Each time an article changes hands, the price becomes higher. When the article is sold for the last time, the price may be much higher than its original cost.

For example, let us take eggs. The poultry farm produces the eggs. If the farmer could sell them directly to the consumer, he could sell them for much less than the consumer will finally pay for them. But the farmer does not know who needs eggs. He cannot go all over the city looking for customers. So he sells the eggs to an agent whose business it is to buy up eggs from the farmers in his district.

The agent ships the eggs to the city by the carload. He sells them to a wholesale poultry dealer in the city. This dealer grades the eggs carefully, sorting and repacking them according to their size, freshness, and sometimes color. He sells some of the eggs to men who pack them and place them in cold storage to be sold when eggs become scarce. Later these storage eggs are sold to jobbers who sell them to

hotels, restaurants, bakers, and grocers. Some of the eggs are sold at once to the jobbers, who sell the eggs to the retail stores.

Each time the eggs change hands, the change requires time and work. They have to be handled, packed, counted, and transported. There is some waste of eggs, and the waste has to be charged to the cost. Each one who buys the eggs and afterwards sells them has to receive some pay for his share of the work of getting the eggs to the consumers who finally eat them; so he adds a few cents to the price of each dozen of eggs to provide his pay. All these costs are included in the price which the consumer, or the last buyer, pays the retail merchant.

The men who buy goods in order to sell them to some other merchant or jobber or agent are called *middlemen.* Often there are a number of middlemen who assist in getting the goods from the producer to the consumer. The consumer pays for the cost of each handling of any article he buys. The retail price of the article always includes what the middlemen charge for their share of the work of distributing goods to the consumer.

Perhaps it will be possible some day to have less expensive methods of exchange — ways of distributing which will not cost the consumer so much for the goods he uses. Some of these newer methods of buying and distributing are now being tried out in a few places.

Institutions of Buying and Selling. I. What services do you expect a store to perform? Do you think goods bought

in stores offering these services should cost more than goods bought in stores which do not have them? Why?

II. Make a list of some of the expenses of a storekeeper. Perhaps you will have to ask some storekeeper about this. Tell him why you are interested in this problem.

III. Explain why chain stores can often sell goods a little more cheaply than small neighborhood stores. Have you ever heard any objections to such stores? If you have, what are they? Discuss these objections.

IV. List the kinds of stores, markets, and different shops in your neighborhood. Opposite each, write the kinds of goods handled.

V. Find the term *department store* in the encyclopedia and read what is given. Explain how a department store differs from a retail store which sells only one type of goods.

VI. Why do we have as many middlemen as we have today? Can you think of any goods which your family buys direct from the producer? Ask your grocer to tell you, if he can, how many dealers have handled a crate of oranges before it reached his store.

VII. Ask your mother to let you keep account of the cost of the following articles of food for a week to see which are costing the most money. Arrange them in a table according to the amount spent on each item.

meats	sugars	vegetables	dairy products
fats	fruits	beverages	baked goods

VIII. Make a list of the institutions which sell services in your community. State opposite each the kind of service sold.

SETTING STANDARDS

In the earliest times people were much less exact in their methods of exchanging goods than we are today. They did not have standards of measurement. They guessed at lengths and widths and thicknesses. They also guessed at distances, at time, and at weights. They guessed at the quantity of grain or other foods that their containers held. They guessed at all those things about which we try today to be exact. They did not understand what exact measurement was or appreciate its value.

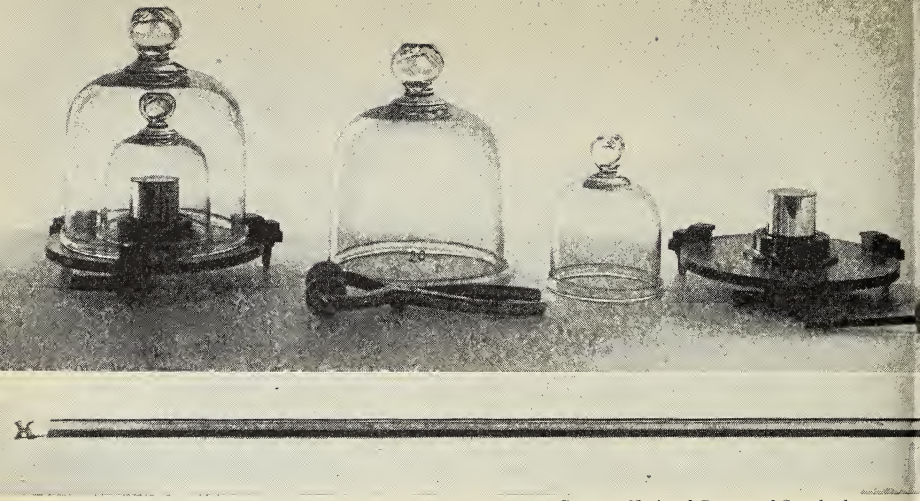
Because of the lack of exact measurement, the work done by the primitive people could not be exact. We want our houses to be built by careful measurement. To primitive people a few inches more or less did not matter. We want our grain to be weighed carefully and to be exactly the right amount. But to them a few pounds more or less did not matter. They estimated weight by the appearance and size of an article.

Because primitive people did not have standards of weight and measurement, they were forced to use general terms in describing quantity or quality or value. They spoke of things as heavy or light; big or little; long or short; good or bad. These are guessing terms. They are not exact. They are not really terms of measurement. Such terms as inch and ton and pint and ounce and hour and gallon had not yet been invented.

Today men measure and weigh and keep exact records. The records can be exact because they have exact terms to use. Men today are exact in buying and selling because they have standards of exactness. Standard terms have crept into the language of people, just as standard measurement has crept into their activities.

If you were to visit Washington, D. C., our national capital, you would find there a house of wonders. It is the Bureau of Standards. The Bureau of Standards is one of the most important institutions in our country, for it is provided by our Federal Government to assist sellers and producers of goods to have standard measures and standard values. It is a great scientific laboratory, one of the greatest in the world. It occupies twelve large buildings and seven smaller ones. Nearly a thousand people work in it, studying the problems of accurate measurement and of quality. Our Federal Government spends nearly three million dollars a year upon the study of these problems.

We buy a great many commodities by measure. It is one of the duties of the Bureau of Standards to see that correct measures are possible — that a ton, a foot, a gallon, a yard, and a pound may be the same to every consumer. Makers of weighing instruments and of measuring instruments may have their measuring devices checked by the Bureau of Standards. For factories and mills that measure the goods they produce, it will see that gauges and measuring tools are accurate. Because of the Bureau



Courtesy National Bureau of Standards

NATIONAL STANDARDS OF MEASURE

The national prototype meter is the gauge of our measures of length. The national prototype kilogram (under the double glass bell) is the gauge of our measures of weight.

of Standards and its work, we can measure quite exactly degrees of heat and cold, cubic feet of gas, yards of ribbon, gallons of gasoline, pounds of meat, and tons of coal. We can measure accurately electricity and time and distances and air pressure. The Bureau of Standards stands ready to check up any measuring instrument in the United States at any time.

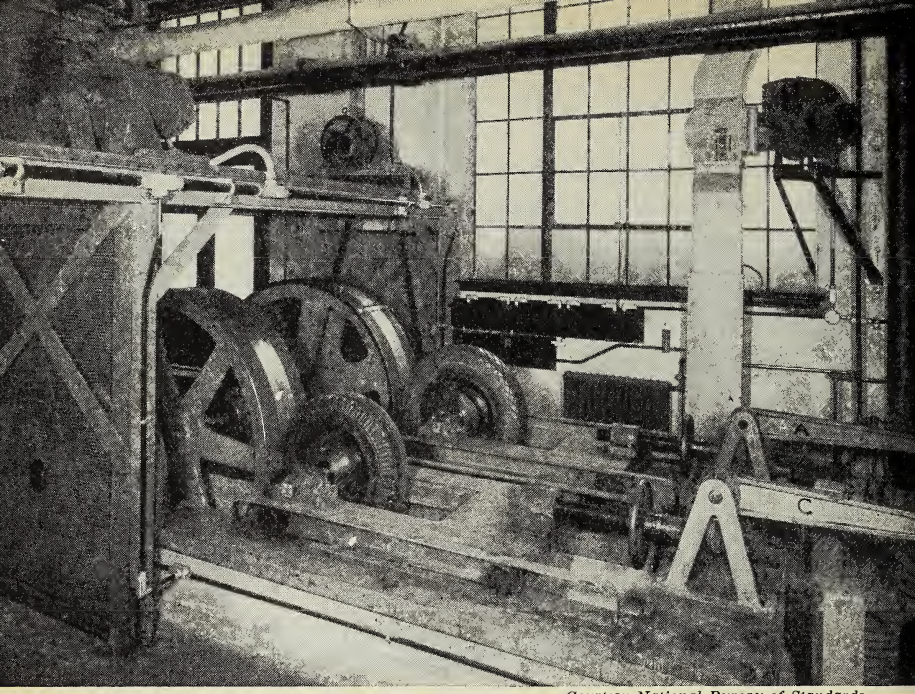
In the main building occupied by the Bureau of Standards is a vault which contains the national standards which govern all weights and measures in the United States. The temperature in this vault is kept the same both night and day, summer and winter. Why? Because a change in temperature brings about a change in metal. Heat causes metal to expand — grow larger. Cold causes metal to contract — grow

smaller. A standard must remain always the same. Probably nowhere in the whole world can be found instruments more delicate than those used as standards for all other instruments of measurement and weighing.

So delicate are the machines used in the Bureau of Standards that experts can weigh objects to one part in a billion. They can find the difference in weight of a man's signature before and after a *t* is crossed. They can place twenty-five thousand parallel lines within the space of an inch with no error in spacing as much as one millionth of an inch.

Of what value is such a Bureau to the people of America? It is of more value than you would ever guess. Your groceries are bought and paid for according to standards of weight and measure set up by the Bureau of Standards. The temperature of a room or of any substance can be measured with a thermometer that can be correct to one tenth of a degree. Your electric lights have been improved by standards of lighting worked out by the Bureau. The coal you buy is weighed on standard scales. The medicine you take is made safe because each thing that the druggist adds to the mixture is weighed and measured on delicate scales set to the standard of the Bureau.

The Bureau of Standards also tests the quality of materials. Manufacturers use the Bureau of Standards in making their goods. Nails are tested for strength. Paper is tested for strength, durability, and finish. Glass is tested for transparency. Everything



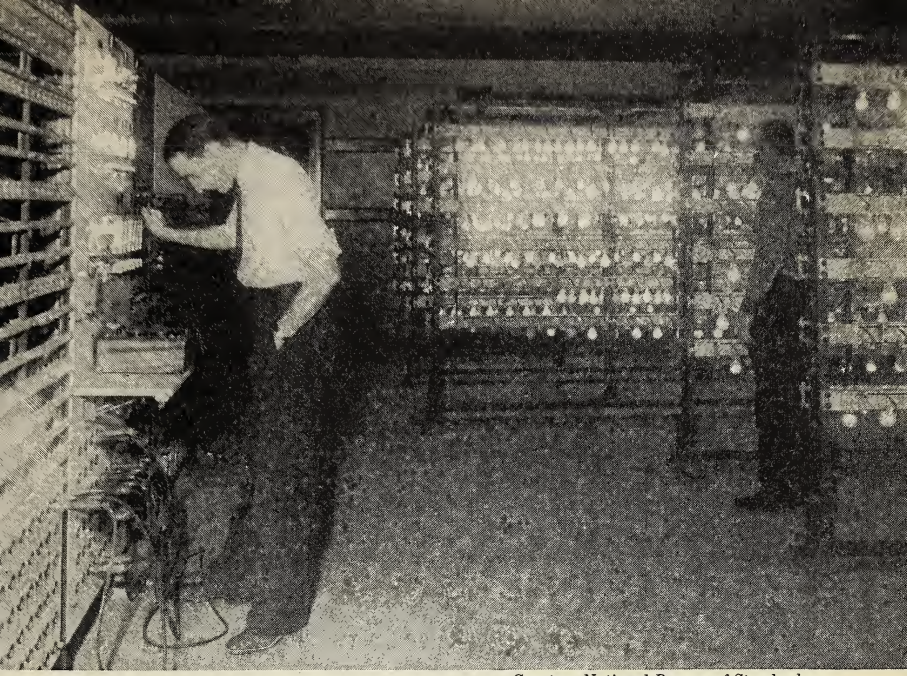
Courtesy National Bureau of Standards

TESTING AUTOMOBILE TIRES

from tacks to timber, from typewriter ribbons to telephone poles, and from tools to tires may be tested for durability or strength or safety or whatever it is that manufacturers want for their goods.

There is a giant furnace in the Bureau in which full-sized walls of houses can be built. The walls may be made of any materials which manufacturers wish to test for fire resistance. The walls are exposed to heat and flame, in order to find out the best materials to be used in constructing houses. Is it not important for us to know how fireproof the walls of our houses are?

Men developed their standards of quantity long before they became interested in standards of quality



Courtesy National Bureau of Standards

TESTING LIGHT BULBS

and value. It is easy to see why this is so if you will watch children. A little child wants the biggest apple, not the best one. He wants the largest piece of candy, not always the most delicious piece. People were like children in the early days of measurement. They wished first to be sure that the quantity was correct. They were willing to risk their own judgment as to the quality of the cloth or potatoes or milk. Some people still are inclined to buy according to quantity rather than quality.

Standards of quality are developing rapidly in the United States. Today, men are demanding quality as well as quantity in milk. It is not enough to know that the bottle in which the milk is delivered holds

exactly one quart. It must be labeled to show its quality. Grade *A* stands for the best quality. Milk, butter, eggs, oranges, and many other foods are graded. We have tests for wool which tell us whether the garments we buy are made from new wool or reworked wool. We have tests for quality of linen and cotton, of medicine, of foods, of building materials. We are becoming more and more concerned with the quality of the goods we buy.

Perhaps the Bureau of Standards will sometime see that it might be as much help to those who buy as to those who sell. Perhaps the people of the United States will demand that the Bureau give as much service to the ones who buy as to those who make things to sell. If the Bureau is to be of help to buyers, it will have to find some way to report to the people the wonderful things it is accomplishing. Perhaps there is nothing that the people of the United States need more than better standards of quality and value which they can use and understand, standards of value which will guide them in buying goods, standards of value which will protect them from dishonest merchants, standards of value which will make the money they have go further than it goes today, standards of value which will bring greater satisfaction and comfort to those willing to use them.

The Bureau of Standards. I. Explain why it is important to have an institution which makes a study of measurement.

II. Find a description of the Bureau of Standards in the encyclopedia and read it. Make a list of new ideas you found in the article.

III. Look in your arithmetic text for the tables of weights and measures. Examine the words used in these tables. See whether you can find out how these terms of measurements came to be used.

IV. Mention some measurements of value which we have today. Can you think of some measurements of value that we need?

V. Try to find out how it happens that producers make greater use of the Bureau of Standards than consumers. Give some good reasons why consumers should make better use of the Bureau.

THE SERVICE OF THE BANK

The first coins used by early groups of people were made by private coiners — perhaps merchants who had received gold or silver rings or copper bars in exchange for goods. They melted the bars or rings, molded coins from the melted metal, and placed their stamp or seal upon them. The value of the coin depended upon its weight and upon the kind of metal from which it was made. Each coiner could make coins of any size or weight or value. Since this was true, and since there were many private coiners, there was a large variety of coins passing through the great trade cities of early times. How could a merchant know the value of any coin?

Because of the confusion of coins, there came to be men whose business it was to value and change money — money-changers, they were called. These money-changers stationed themselves in markets or other public places and served people by telling them the value of any coins brought to them, or by changing foreign coins for the coins of their own country. Each money-changer sat upon a wooden bench, and beside him or upon a table before him he had a scale. He weighed each coin, clanked it upon the bench to see whether it were pure metal, and then stated the value. For his services he held back one or more coins as a fee. Often he exchanged coins for coins of another kind that his customer wanted.

Probably a good many of the money-changers held back more than a just fee, for the money-changers came to be known as drivers of sharp bargains. Since they knew more than their customers about the values of different kinds of coins, they were able to make exchanges in coins work to their own advantage; that is, they would give back to the customer not enough value for the coins the customer had turned in. So the people grew suspicious of the money-changers and feared to deal with them.

Besides this difficulty, there was another problem in these early days of coined money. Many private coiners made what we now call counterfeit coins — gold or silver or copper coins that were not worth what they were supposed to be worth. Indeed, some money coined by rulers of countries was of uncertain

value. How was one to know good money from bad money? How was one to know what any coin was really worth without putting himself at the mercy of the money-changers?

It was because of this confusion in coinage value that banks came to be established in Europe in the Middle Ages. In the beginning, it was the chief business of these banks to decide between good and bad money, to set the standard value of money, and to supply good money.

In Venice the stalls of the money-changers were the first banks. Some people who had a good bit of coin would deposit their coins with a money-changer for keeping. The money-changer would give the depositor a statement for the amount of money he deposited, and he might use that statement in paying for goods he bought, just as we might use a check today. If the money-changer had a quantity of coin in his keeping, he might lend some of it to a man in need of money. For the use of the money, he would charge the borrower interest.

In Florence a number of private bankers began to go into the business of receiving deposits and of lending money for interest. These private bankers were men of wealth who became very powerful in the affairs of trade and even of the government.

Today our banks are a very important part of our business life. Some of our banks are savings banks which receive deposits of money from people who wish to save money. These savings banks pay

Ewing Galloway

STORAGE VAULT OF A GREEK TREASURY

interest on the money deposited with them. By putting his money in a savings bank, a depositor makes the money earn more money for him. At the end of a year five hundred dollars deposited in a savings bank will have become five hundred dollars plus the interest it has drawn. So one service of a bank is to help increase a person's money.

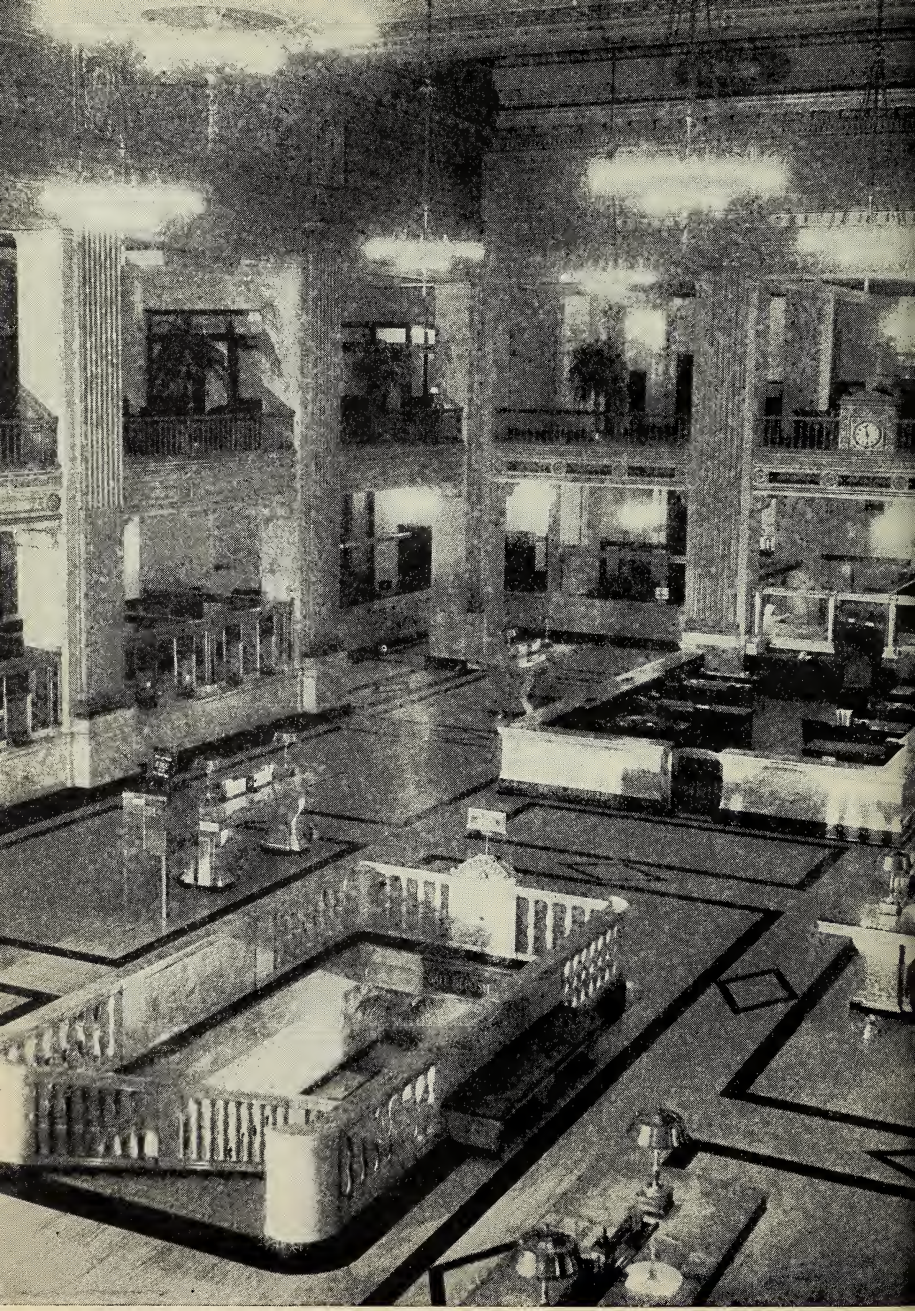
How can a bank afford to pay interest? Because it uses the money that the depositors leave with it. It invests the money and makes it earn more money. Some of the money which it earns is given to the depositors as interest. Some of it is kept by the bank to pay it for the service it performs for people.

Philip D. Gendreau

FEDERAL RESERVE BANK IN WASHINGTON

Commercial banks lend money. There are many people who want to borrow money. There are many reasons for borrowing money. A man may wish to start a new business. He may have to borrow money in order to do so. A man may wish to enlarge the business he already has. A farmer may need money to live on until his crop is sold. He may wish to buy land. He may need money with which to pay for seed or to pay his taxes. Farmers often borrow money.

The bankers accommodate the business men and the farmers of the community by lending them money which they can use to carry on their work.



Ewing Galloway

INSIDE ONE OF OUR MODERN BANKS

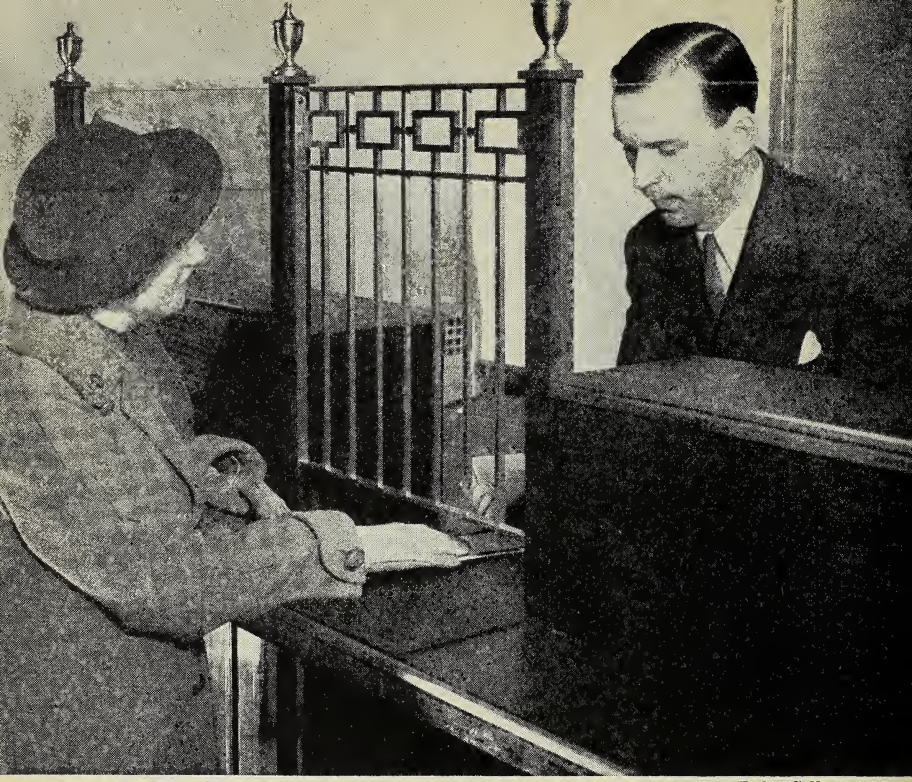
By charging interest on the money they lend, the bankers make the money work for themselves, too.

Where do bankers get the money they lend to others? They get some of it by selling shares in the bank. The people who buy the shares become part owners of the bank. They are called *stockholders* or *shareholders*. The money which the shareholders put into the bank may be used in two ways. Part of it may be used for carrying on the work of the bank. It may go for expenses, or it may be loaned out for interest. Part of the money, however, has to be kept aside to protect the depositors. The Government requires that part of the money owned by the bankers be kept in reserve. The stockholders share in the profit made by the bank. If the bank fails, each stockholder has to bear his part of the loss.

Banks also serve the public by allowing people to carry checking accounts with them. Many people deposit money in a bank, not for savings, but for safety and convenience. Each week or month they deposit their earnings in the bank and pay their bills by check. Such a deposit is called a *checking account.*

Banks do not pay interest on checking accounts because a depositor may draw money from his checking account any time he wishes to do so. The bank cannot depend upon this money for loans. Often a depositor leaves money in the bank only a short time.

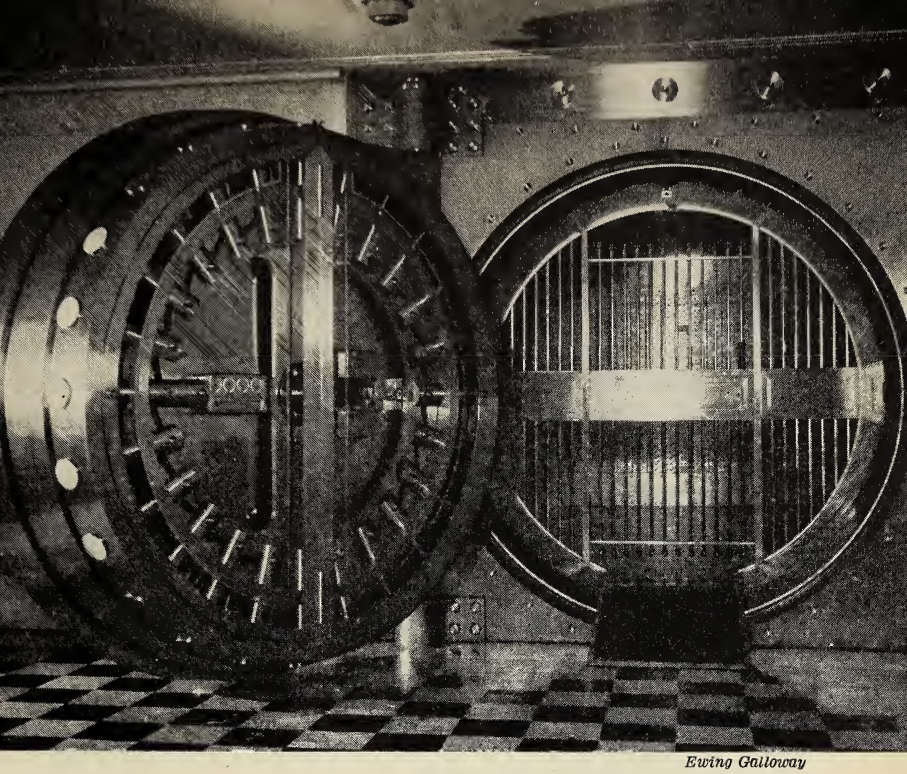
Depositors draw money from their checking accounts by writing checks. A check has the name of the bank printed on it. It has blank spaces



Ewing Galloway

DEPOSITING MONEY IN A BANK

which are to be filled out by the depositor. There is a space in which to write the date and another space in which the amount of money is to be written. There is a space to be filled with the name of the one to whom the money is to be paid, and there is a space for the name of the depositor. All these spaces have to be filled in carefully. The bank clerk can compare the signature on the check with the signature of the depositor which is on file at the bank. In this way he can be sure that the check was written by the depositor.



Ewing Galloway

ENTRANCE TO A MODERN BANK VAULT

Checks are used by depositors instead of money. A check is an order for the bank to pay out some of the money which the depositor has placed in the bank. The bank must do as it is ordered to do.

Much of the buying which is done in the United States is done without the use of coined money. It is done with checks. For example, Mr. A buys a house from Mr. B. Mr. A writes a check for six thousand dollars and gives it to Mr. B. Mr. B takes the check to the bank and deposits it to his account. The bank does not give Mr. B money. It merely

makes a change in the books in which the accounts of Mr. A and Mr. B are kept. It subtracts six thousand dollars from the account of Mr. A and adds six thousand dollars to the account of Mr. B. No money is exchanged in making this sale.

Sometimes a bank may lend money to people who are unable to repay the loans. If this happens too often, the bank fails. This means that the stockholders lose money they have put into the bank. But it means something even worse than that. It means that the depositors may lose money which they have deposited in the bank.

Institutions of Borrowing and Lending. I. Make arrangements to visit a bank. The bank will probably provide a guide who will explain things to the class. You may want to prepare a list of questions, such as the ones below, to ask your guide.

1. How does a person deposit money?
2. What does the banker do with the money which is deposited in his bank?
3. Why can a bank pay interest on money?
4. How is money withdrawn from the bank?
5. What does one do to start a savings account?
6. What are some of the purposes for which banks will lend money?

II. Explain what is meant by each of the following terms:

savings account	depositor	interest
checking account	stockholder	check
money-changer	deposit	loan

VI. OUR GOVERNMENT AND OUR MONEY

The people of the United States use coins and paper money. Where do we get our money? Of what is it made? How is it made? Who has the responsibility of coining the money of the United States? Who provides that there is the right amount of money in circulation?

OUR TREASURY DEPARTMENT

Each nation has its own money system. The government of a nation usually has the sole authority to coin money. Usually it has the authority to say how much money shall be in circulation and to make laws about its use.

The money of the different nations is not all alike. If you were to travel in China or Mexico or Australia or France, you would find the people of each of these countries using coins and paper money which are quite different from the money which we use here in the United States. You would notice that the designs stamped or printed on the money are not the same as those found on United States money. In some cases you would find that even the materials used for making money are not the same.

At first, you probably would be confused in trying to use foreign money. You would not be able to

recognize the names of the different coins. You would not know the value of the coins, and it might take you a long time to learn to make change. But, in time, you would learn to know the foreign systems of coinage and be able to use foreign money with ease.

In the United States the Federal Government has the only authority to coin money. Coins made by any person or institution other than the Federal Government are counterfeit money, or unlawful money. Anyone making counterfeit money can be punished.

The Congress of the United States makes all laws about money. It decides upon the kinds of money we shall use; it provides for the coinage of money; and it controls the uses to which the money in the Treasury can be put.

The Federal Government has a Treasury Department which attends to its money matters. The Treasury Department is the head of the whole money system of the United States. At the head of the Treasury is a man called the Secretary of the Treasury. He is appointed to his position by the President. He is responsible for issuing the money we use — for putting it into circulation, as we say.

The Treasury Department has control of the mints which coin our money and of the Bureau of Engraving and Printing which makes our paper money.

People have confidence in the money that a government issues if they have confidence in the government. What do we mean when we say that people have confidence in the money they use? We mean

that people are willing to accept the money in payment of debts. We mean that people are willing to exchange their commodities for money. We mean that a person should be able to accept a coin and know immediately what value he is receiving. Do we have to stop and weigh our coins to see that they have the right amount of metal in them? Do we have to "ring" our coins to see that they have the right kind of metal in them? We do not, because behind our money system is a government in which we have confidence — a government which issues sound money.

Our Treasury Department. I. Read in an encyclopedia about our Treasury Department. Find out the kinds of work done by it.

II. Who is the Secretary of the Treasury at present?

III. Mention some things which might happen if we did not have a strong government department in charge of our money.

OUR METAL COINAGE

You have read about the Bureau of Standards in Washington. You have learned that it contains a standard yard by which any yardstick in the country can be checked, and that any yardstick that checks perfectly with the standard meter in the Bureau is a true yard. You know, too, that there is in the Bureau a standard weight by which all pound weights

in the country can be checked, and that any pound weight that checks perfectly with the standard weight in the Bureau is a true pound. We can refer to the true yard and the true pound as standard measures, because they check with the standard measures in the Bureau.

It is easier to measure a thing than it is to tell its *value*. Even if we do think we know the value of a thing at one time, the value may change later. Money is judged by value. How can men measure or express the value of money?

The value of our money is measured by the value of gold. The standard by which our Government sets the value of its money is a certain weight of gold. That weight of gold is known as a dollar. Any dollar, whether silver or paper, can buy what a dollar's worth of gold will buy. Gold is the standard of value for our money system. It is the standard of value by which the money systems of some other nations are measured. Some nations, however, have money systems measured by the silver standard.

Gold is no longer used in the making of coins in our country. At one time our Government did issue a gold dollar and gold coins of five-dollar and ten-dollar and twenty-dollar values. These coins are no longer in circulation. Our metal coins are now made of alloys, or metal mixtures. Our silver dollar, our half dollar, our quarter, and our dime are made of a silver alloy. Our nickel is made of a nickel alloy, and our penny of a copper alloy.

A silver dollar does not contain a dollar's worth of silver. None of our other coins contain metal equal in value to the value stamped on the coin. But the stamp of our Government on any coin tells us that we may use that coin to buy goods of the value stamped on the coin. Anyone will accept that coin at its stated value in payment for goods or debts because it has the stamp of our Government on it. In other words, it is sound money. Coins which do not contain metal of the value stamped on them are called *token* money. Such coins are signs or tokens of value.

Nearly all coins in the world today are token money. That was not true in the earlier days of coined money when a gold or silver coin was worth the amount of pure gold or pure silver that was stamped upon it. In those days, passing a coin was really exchanging one commodity for another — exchanging gold for whatever was bought. Now, when we pass a coin for an article which we purchase, we are not exchanging a certain amount of metal for an article of equal value; we are really passing a token or sign of value for the article received. It is easy to understand this when you compare coins to paper money or checks. A paper dollar does not contain a dollar's worth of paper; neither does a check for one dollar contain paper to that value. Yet people will accept a one-dollar bill stamped by our Government because our Government says that the paper dollar has the backing of the Government and

that it can buy a dollar's worth of goods anywhere. You will accept a check for a dollar when you know that the person who wrote the check has money in the bank which issued the check.

Token money and paper money are promises. As long as such money is issued by a sound government whose credit is good, it is as good as the gold or silver for which it stands.

In the early days when a gold coin was valued at the price of the gold it contained, the coin was not only money — it was also a commodity. Such money in those days was wealth. But is our money today wealth? Our money is only a medium of exchange in trading commodities and services. Our wealth consists of our commodities — our property. Our money is not wealth.

Token Money. I. Explain carefully the differences between the use of token money and the use of commodities as money.

II. Mention some kinds of commodities which have been used as money.

III. Mention the different kinds of token money we use today.

Value of Money. I. Explain why a piece of money does not contain metal enough to equal its value in goods.

II. How could we know the real value of money? Do we need to know its real value? What do we mean by *face value* of money?

MAKING METAL INTO MONEY

The United States Government has offices where the precious metals which are to be made into money are received. In these offices the value of the metal is decided. We call this *assaying* the metal. For this reason, the offices are called *assay offices.*

Assay offices are located in New York, Denver, San Francisco, New Orleans, and several other cities. The mining companies send their precious metal to these offices.

The assay office examines this metal so that the Government will know the quantity and the degree of fineness of the metal and how much to pay for it. The metal is weighed by two men at different times. Then it is melted, stirred, and poured off into iron molds to cool in the form of heavy bars. Small pieces are chipped from the two ends of each of these bars to be tested by men called *assayers.* The fineness of the metal is agreed upon. The value of the metal is computed by three other men. After this the bars are sent to one of the Government's three refineries. In the refinery the impurities are removed from the metal. Sometimes this is done by the use of chemicals and sometimes it is done by passing an electric current through the metal. When all this has been done, the metal is sent to the mint.

In the United States we have three mints where metal is coined into money. One is in Philadelphia,

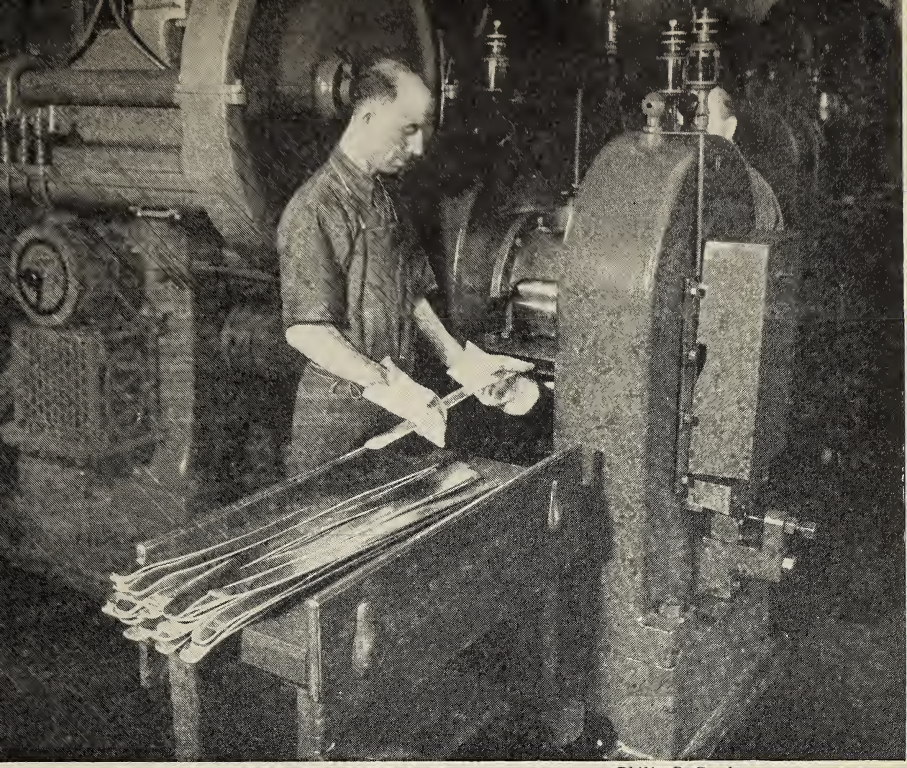
Ewing Galloway

BARS OF GOLD FOR OUR TREASURY

one is in Denver, and one is in San Francisco. All of our coins are made in these three mints.

Much of the metal received at the mints is not coined. It is stored in bars or ingots. Each bar or ingot is carefully weighed, and its value in dollars can be known just as easily as though it were made into coins. These bars or ingots are sometimes used as money in large transactions.

When the gold and silver bars leave the refinery, the metal is very soft. Pure metal does not make good money, for it can be easily dented or chipped



Philip D. Gendreau

ROLLING SILVER METAL INTO STRIPS

or bent out of shape. So the gold bars and the silver bars are melted, and each metal is hardened by adding the right amount of copper. The mixture is called an alloy. The gold and silver alloy is then cast into bars in preparation for coinage.

The bars which are to be made into coins are passed between heavy steel rollers eighteen to twenty times until the bar is a thin strip just flat enough and just thick enough to make the coins the correct weight. Then the strips are passed through cutting machines. From these machines the metal comes out in disks,

or blanks, just a little larger than the coin should be when it is finished. The blanks are called *planchets.*

These blanks are then weighed. Each one must be exactly the right weight. If one weighs too little, it is sent back to be melted over again. If it is too heavy, it is filed down.

Next the blanks are put through a machine that by pressure raises the edge a trifle above the rest of the blank. This raised edge protects the design which is to be placed on the coin, making it last longer.

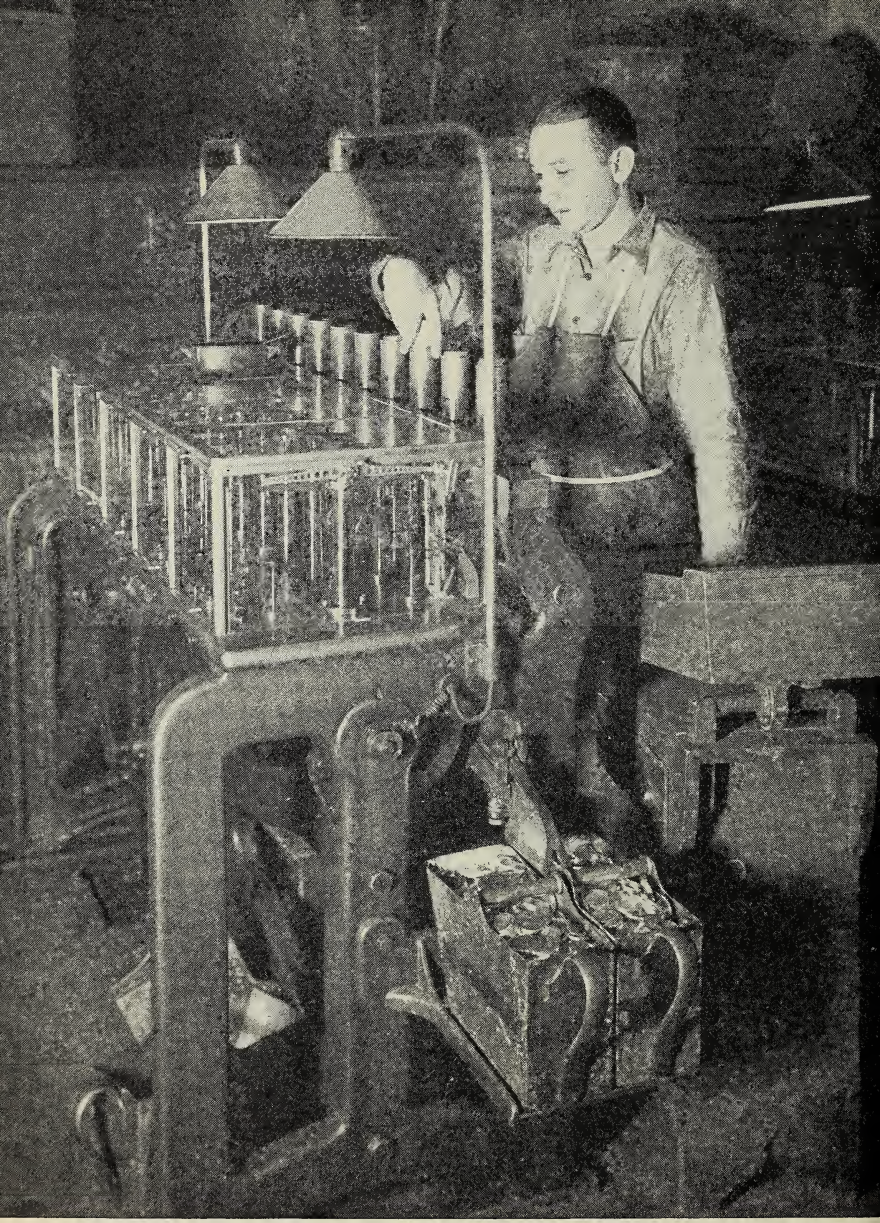
After the blank has been purified and cleaned by reheating, it is ready to receive the stamp of the United States Government and become money. The stamping is done by a machine which seizes the coin, centers it, and presses it between two dies, each of which has a design upon it. On all of our coins you will see different designs on the two sides of the coin.

While the coin is being stamped, it is fitted into a ridged collar. The pressure of this collar cuts ridges into the thickened edge of the coin. This process is called *milling.* Do you know why coins are milled? In the early days of coinage, when pure gold and silver were used for coins, there were people who wanted gold and silver badly enough to steal some from the coins. Sometimes they would nick a bit of gold out of the edge of the coin. Sometimes they would file a few grains of precious metal off the edge of the coin. Often such mutilation of the coins was done so skillfully that one could scarcely tell that the coin was underweight — that it had been "robbed."

Courtesy U. S. Treasury Office

CUTTING PRESS

This press cuts out the blanks, or planchets, from the sheets of metal.



Courtesy U. S. Treasury Office

WEIGHING UNSTAMPED COINS

An automatic weighing machine weighs the blanks to check them before stamping.

Courtesy U. S. Treasury Office

STAMPING THE BLANKS

The design on the face of the coin and the raised edge are stamped in this coining press.

Courtesy U. S. Treasury Office

COUNTING COINS

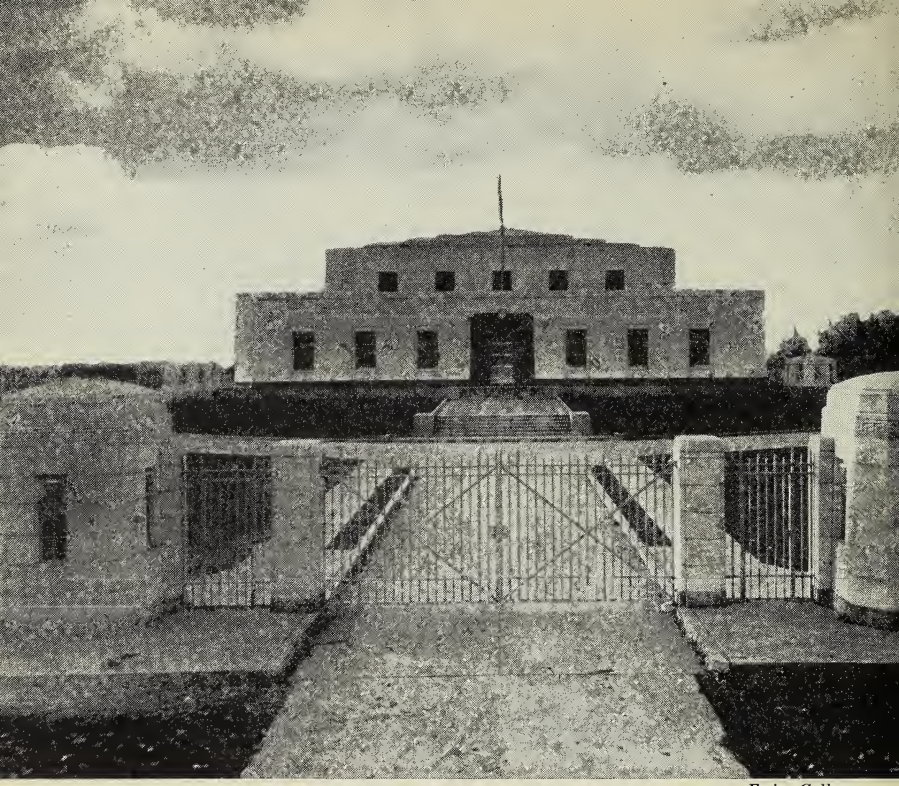
An automatic counting machine counts the coins and drops them into sacks.

That was one reason why the money-changers constantly weighed the coins. When rulers and governments later coined the money, someone thought out the idea of milling the edges of the coins so that any attempt to file metal from the coin could be easily detected. To this day, most coins have milled edges.

The coin is finished. It needs only to be weighed and tested before it is allowed to leave the mint. Coins are tested by ringing. If a hollow spot or bubble has formed in the metal, the coin will not sound right when thrown on a wooden surface. It is said that every coin is weighed at least twenty times after it is made into disks.

Some of the coins which leave the mint are stored in the United States Treasury. Other coins are exchanged for bills. Storekeepers, bus drivers, and other business people need a great deal of small change in order to carry on their businesses. Anyone may take bills to the bank and exchange them for an equal amount of money in coin.

The gold coin, which is no longer used in our country, is also kept in storage. It is estimated that our storage vaults contain about half of all the gold in the whole world. This does not mean that we have large amounts of gold, for one of the reasons gold is precious is that it is scarce. The precious metal which is not coined is stored by our Government in huge vaults. One of our new storage places is at Fort Knox, Kentucky.



Ewing Galloway

GOLD DEPOSITORY AT FORT KNOX

All the gold mined since the discovery of America could be melted into a block measuring only forty feet each way.

Coining Money. I. Read in an encyclopedia about the mints where money is coined. Explain why assaying is necessary.

II. Explain why coins are weighed so many times.

III. Study a coin and list ten facts which you discover about it. Perhaps your class might make a collection of different kinds of coins.

OUR PAPER MONEY

The metal coins of our money system are very convenient. Quarters, half dollars, dimes, nickels, and pennies are in constant use. But many people consider a silver dollar heavy and inconvenient. Five silver dollars will weigh down a purse or a pocket. For that reason, many people prefer our paper money. It would take quite a roll of paper bills to weigh as much as five silver dollars.

Back in the days of our colonies, when coins of other countries were scarce, a few of the colonies issued paper money. But such paper money was not generally accepted, for the separate colonies did not have strong governments with treasury departments having gold or silver in storage.

When the colonies fought the war of the Revolution, they issued paper money so that they might buy supplies and pay soldiers. So did the Continental Congress, which was a group of men representing all the colonies. But as the Continental Congress had no treasury, and as it could not tax the people to raise money, this wartime paper money soon became worthless also. People were afraid to accept it because it did not have a strong government behind it.

For some time after the Revolution had been won and the Federal Government of the United States had been established, even the Federal Government did not issue paper money. During that time some of the private banks issued paper money.

A paper one-dollar bill is worth a dollar only when it can be taken to some place and exchanged for one dollar in standard metal coinage. A paper dollar is only a promise to pay, just as a check is. When some private banks issued "promises to pay" or paper money in greater amounts than the money they had in their banks, people again became suspicious of paper money. For that reason, our Government forbade all private banks to issue paper money. Only national banks, whose books were inspected by the Government, were allowed to issue it. Then the Government itself began to issue paper money. These first paper bills were called *greenbacks*, and they were not at first backed up by money in our National Treasury; but later, as our supply of bullion increased, the greenbacks became perfectly good "promises to pay" and were accepted everywhere.

Not many years ago our Government established twelve banks, known as Federal Reserve Banks. These banks have large reserve supplies of bullion and metal money, and they issue *notes*, or paper money. Much of our paper money at present consists of bank notes from these banks.

The Government also issued what are called gold certificates and silver certificates. These certificates were also promises to pay, in gold or silver, whatever value was stated on the certificate. The gold certificates are no longer issued, for our Government no longer pays out gold coins. But many of our paper bills are silver certificates issued by our Government.

Most of the money now in use in this country is paper money. It is estimated that we have about six billion dollars in paper money in circulation and not quite a billion dollars in metal coins. So our paper money in circulation is about six times the value of our metal money in circulation. We are willing to accept paper money because we have faith in our Government's "promise to pay."

Paper money is not wealth. It is not a commodity. It is useful to us because we can exchange it for the services or commodities which we need to satisfy our wants. It is of value to us and of use to us only because of what it stands for.

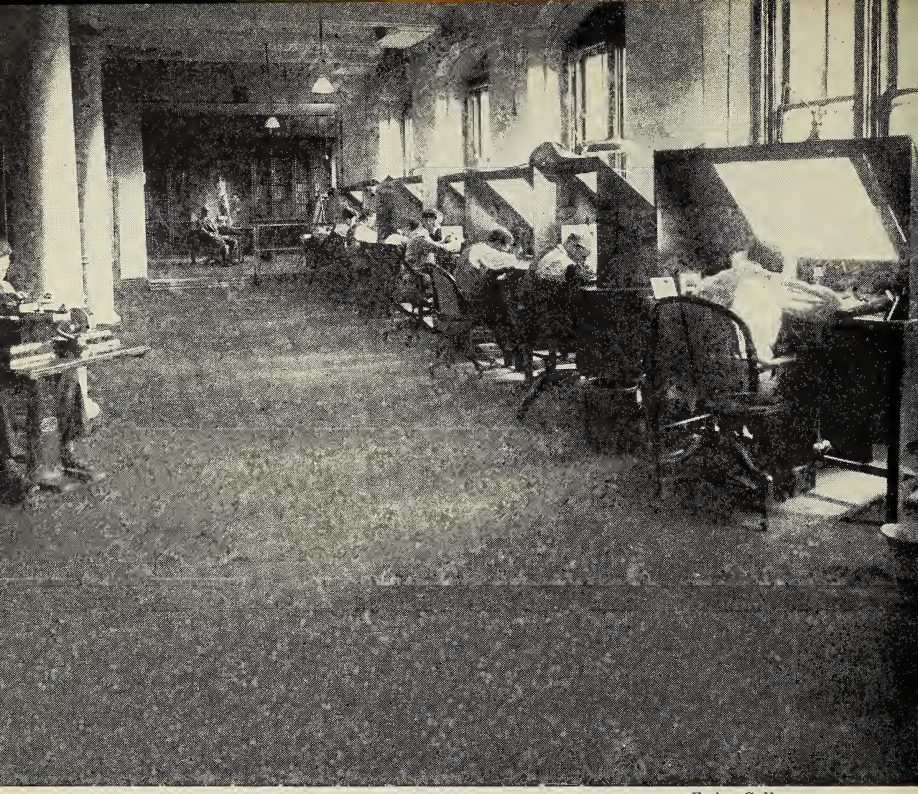
MAKING PAPER MONEY

Paper money is made in the Bureau of Engraving and Printing at Washington. The money is made under the supervision of the Treasury Department of the United States.

Making the design is the first step in making paper money. Expert draftsmen draw the design on paper. They make the design four times as large as the bill is to be because they can be more exact if they make it large.

When the design is finished, it is approved by the Secretary of the Treasury, after which it is photographed. When the bill is photographed, it is reduced to the correct size.

This photograph is then etched on a steel plate by expert engravers. The work must be carefully done,



Ewing Galloway

ENGRAVING DESIGNS FOR PAPER MONEY

as there are many delicate lines to be made. The engravers are taught to do this work by the Government. Each engraver works on only one part of the design. One may do the portraits and pictures, another do the lettering, and a third the pattern along the border. It takes the engravers several months to engrave the master die, as it is called.

Finally when the die is completed, a proof sheet is printed from it. This sheet is examined carefully for flaws. If none are found, the die is approved. This proof is the only copy printed from the die, for

Ewing Galloway

PRINTING PAPER MONEY

the bills are printed from electrotypes made from the master die.

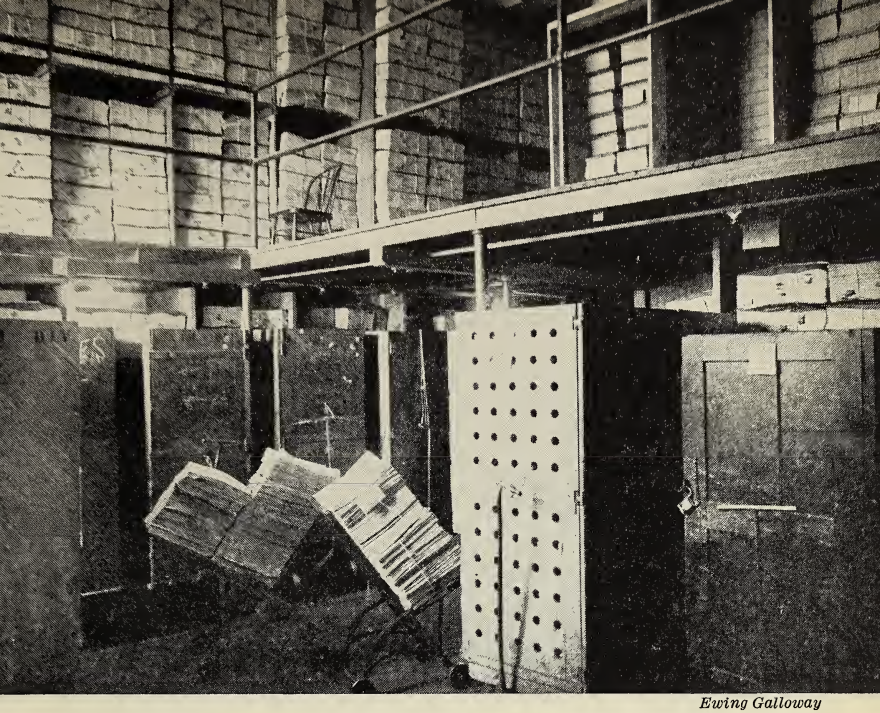
The paper used in making money is made in Dalton, Massachusetts, at the Government mills. It is made of cotton and linen rags. The rags are made into pulp, as in the case of other paper. While the pulp is being rolled on the huge roller, colored threads are placed on top of the pulp. The rollers press these threads into the pulp, making it strong. The details of the process of making paper for money are secret, known only to those working at the mill.

Ewing Galloway

CHECKING PAPER MONEY FOR PERFECTION

Paper money is carefully printed by means of special hand presses on the paper made especially for the printing of money. Four bills are printed at each impression of a press, but only one side of the bills is printed at one time. The reverse side of the bills is printed first. The sheet is dried over steam, and the face of the bill is then printed. After the sheets are dry, the edges are trimmed. Then the sheets are run through a machine which places the serial number and the official seal on each bill.

The sheets are then cut apart, and the bills are counted into packages of one hundred. Forty of these packages are made into a larger package of



Ewing Galloway

A STORAGE VAULT FOR PAPER MONEY

four thousand bills. The packages are then turned over to the Treasury Department, where the money is counted again, sealed, and labeled. The packages are then sent to the vaults to be stored until the money is needed.

Bills become soiled as they are used. Experts have learned how to launder the bills. Soiled bills are returned to the Treasury, where they are washed, starched, and ironed. When the process is finished, the bills are crisp and clean and once more ready to go into circulation. This method of cleaning paper money saves the United States Government thousands of dollars.

Ewing Galloway

CHECKING WORN BILLS

The life of most one-dollar bills is less than one year. The life of five-dollar and ten-dollar bills is somewhat longer, for bills of large denominations do not pass through so many hands in a short time as do bills of small denominations. The life of hundred- and five-hundred-dollar bills is still longer. When bills become torn or frayed at the edges, they are sent to Washington to the Redemption Division of the Treasury Department. There the bills are destroyed in a machine which makes them into pulp. Every bill sent into the Redemption Division has to be accounted for. Bills partly destroyed by fire or flood or machinery may be sent to the Redemption

Ewing Galloway

SORTING PIECES OF DAMAGED BILLS

Division. If three fifths of the damaged bill is there, the owner will be given a new note.

Since paper money is destroyed rather rapidly, the Bureau of Engraving and Printing is always busy making new bills. More than a billion bills are usually printed in one year.

Paper Money. I. Examine a dollar bill. Find out at least ten important facts about it and arrange these facts in an outline under the following headings: (1) Size and shape, (2) Design, (3) Material, (4) Signature of the Government.

II. Give some good reasons for the use of paper money.

III. Read in an encyclopedia to find out how paper money is made. List some facts given there that are not given in your book.

IV. Write a paragraph explaining how it happens that we see so little old or torn paper money.

THINKING BACK

Perhaps you and your classmates will enjoy discussing these problems:

I. The Greeks valued their coins by the value of a real ox. How was their idea of money different from ours? Was their idea better than ours?

II. What are some of the problems about money which you still do not understand? Make a list of such questions. Discuss how you might find answers to your questions.

III. Discuss some important differences between money and moneyless civilizations. What are some of the advantages of each? The dangers of each?

IV. Mention some things which you think are important which money will not buy.

V. It has taken thousands of years to develop money as we have it today. Do you think our ideas of money will ever change? Why do you think as you do?

A PRONOUNCING LIST OF PROPER NAMES

The names in this list are marked to show how they are pronounced. You know that the accent mark tells you which syllable to say the hardest. There are marks over some of the letters to show how the letters sound. This table of letter sounds will show you what the marks over the vowels mean.

ā as in āte	ē as in bē	ō as in hōpe
ã as in vãcation	ę̄ as in hę̄re	ŏ as in ŏmit
ă as in ăt	ĕ as in ĕvent	ŏ as in hŏp
â as in câre	ĕ as in lĕt	ô as in ôr
ä as in cär	ẽ as in ownẽr	ŏ as in cŏnnect
å as in påss	ĕ as in silĕnt	o͞o as in fo͞od
ă as in ănother		o͝o as in fo͝ot
ȧ as in ȧbout	tu͡ as in natu͡re	
ī as in hīde	ū as in ūse	û as in tûrn
ĭ as in hĭd	ŭ as in ŭnite	ü as in menü
ĭ as in charĭty	ŭ as in ŭs	ŭ as in minŭs

Aegina (ē-jī′nȧ)
Africa (ăf′rĭ-kȧ)
Akron (ăk′rŭn)
Alaskan (ȧ-lăs′kăn)
Alexandria (ăl′ĕg-zăn′drĭ-ȧ)
Allegheny Plateau (ăl′ē-gā′nĭ plă-tō′)
Antwerp (ănt′wûrp)
Appalachian (ăp′ȧ-lăch′ĭ-ăn) Mountains
Arabia (ȧ-rā′bĭ-ȧ)
Arkwright (ärk′rīt), Richard
Asia Minor (ā′zhȧ mī′nẽr)
Assyria (ă-sĭr′ĭ-ȧ)
Assyrians (ă-sĭr′ĭ-ănz)
Athens (ăth′ĕnz)
Australia (ôs-trāl′yȧ)
Austrians (ôs′trĭ-ănz)
Babylonia (băb′ĭ-lō′nĭ-ȧ)
Babylonians (băb′ĭ-lō′nĭ-ănz)
Belgium (bel′jĭ-ŭm)
Berlin (bûr-lĭn′)

Bessemer (bĕs′ĕ-mĕr)
Boone (bo͞on), Daniel
Boulder (bōl′dĕr) Dam
Brazilian (brȧ-zĭl′yăn)
Cartwright (kärt′rīt), Edmund
Cascade (kăs-kād′) Range
Ceylon (sē-lŏn′)
Chanute, Octave (ŏk-tāv′ shȧ-nūt′)
Chinese (chī′nēz′)
Civilian Conservation Corps (sĭ-vĭl′yăn kŏn′sĕr-vā′shŭn kōr)
Clerk-Maxwell (klärk′măks′wĕl), James
Clermont (klĕr′mŏnt)
Clinton, DeWitt (dē-wĭt′ klĭn′-tŭn)
Conestoga (kŏn′ĕs-tō′gȧ)
Conowingo (kō′nō-wĭng′gō) Dam
Constantinople (kŏn′stăn-tĭ-nō′-p'l)
Cornwall (kôrn′wôl)
Crete (krēt)
Cumberland (kŭm′bĕr-lănd) Gap
Cyrene (sī-rē′nē)
Danish (dān′ĭsh)
Diesel (dē′zĕl)
Dixmude (dēks′müd′)
Egypt (ē′jĭpt)
Egyptian (ē-jĭp′shăn)
Euphrates (ū-frā′tēz) River
European (ū′rō-pē′ăn)
Gama, Vasco da (väs′kō dȧ gä′mȧ)
Genoa (jĕn′ō-ȧ)
Georgian (jôr′jĭ-ăn) Bay
Germany (jûr′mȧ-nĭ)
Gibraltar (jĭ-brôl′tĕr), Strait of
Giffard, Henri (än′rē′ zhē-fȧr′)
Glasgow (glăs′gō)
Graf Zeppelin (gräf zĕp′ĕ-lĭn)
Great Khan (kän)
Great Pyramid (pĭr′ȧ-mĭd)
Grecian (grē′shăn)
Guatemala (gwä′tē-mä′lȧ)
Hargreaves (här′grēvz), James
Hebrew (hē′bro͞o)
Hertz, Heinrich (hīn′rĭk hĕrts)
Hindenburg (hĭn′dĕn-bo͞ork)
Hungarian (hŭng-gâr′ĭ-ăn)
Isabella (ĭz-ȧ-bĕl′ȧ)
Italian (ĭ-tăl′yăn)
Janus (jā′nŭs)
Java (jä′vȧ)
Kay (kā), John
Keokuk (kē′ō-kŭk) Dam
Lana, Francesco de (frän-chĕs′kō dē lä′nȧ)
Lilienthal (lēl′yĕn-täl), Otto
Macon (mā′kŏn)
Madeira (mȧ-dēr′ȧ)
Marconi, Guglielmo (go͞ol-yĕl′mō mär-kō′nē)
Mediterranean (mĕd′ĭ-tĕ-rā′nē-ăn) Sea
Merrimack (mĕr′ĭ-măk) River
Mesabi (mē-sä′bē) Range
Mexico (mĕk′sĭ-kō)
Mohawk (mō′hôk) Trail
Mongolia (mŏng-gō′lĭ-ȧ)
Mongolian (mŏng-gō′lĭ-ăn)
Montgolfier (mŏnt-gŏl′fĭ-ēr), Jacques (zhȧk) and Joseph
Muscle Shoals (mus″'l shōlz)
Nahum (nā′hŭm)
New Amsterdam (ăm′stĕr-dăm)

New Guinea (gĭn′ĭ)
Newcastle (nū′kȧs″l)
Newcomen (nū-kŭm′ĕn), Thomas
Newfoundland (nū′fŭn(d)-lănd′)
Nilometer (nī-lŏm′ĕ-tēr)
Papin, Denis (dē-nē′ pȧ′păn′)
Papua (păp′ū-ȧ)
Parliament (pär′lĭ-mĕnt)
Persia (pûr′zhȧ)
Pharaoh (fâr′ō)
Philippine (fĭl′ĭ-pēn) Islands
Phoenicia (fē-nĭsh′ĭ-ȧ)
Polo, Marco (mär′kō pō′lō)
Portugal (pōr′tū-gȧl)
Potomac (pō-tō′măk) River
Promontory (prŏm′ŭn-tō′rĭ) Point
Puget (pū′jĕt) Sound
Roosevelt (rō′zĕ-vĕlt) Dam
Salamanca (săl′ȧ-măng′kȧ)
Salvador (săl′vȧ-dôr′)
Samoans (sȧ-mō′ănz)
Santa Cruz (săn′tȧ krōōz′)
Santos-Dumont, Alberto (ăl-bûr′-tō sän′tōs′ dü′môn′)
Sault Sainte Marie (sōō′ sănt mȧ-rē′)
Savannah (sȧ-văn′ȧ)
Savery (sā′vēr-ĭ), Thomas
Shenandoah (shĕn′ăn-dō′ȧ)
Siam (sī-ăm′)
Siberia (sī-bē̤r′ĭ-ȧ)
Sicily (sĭs′ĭ-lĭ)
Sierra Nevada (sĭ-ĕr′ȧ nĕ-vä′-dȧ)
Solomon (sŏl′ō-mŭn) Islands
Spanish (spăn′ĭsh)
Stephenson (stē′vĕn-sŭn), George
Suez (sōō-ĕz′) Canal
Susquehanna (sus′kwē-hăn′ȧ) River
Swedish (swēd′ĭsh)
Switzerland (swĭt′zēr-lănd)
Tibet (tĭ-bĕt′)
Tigris (tī′grĭs) River
Triborough (trī-bûr′ō) Bridge
Turbine (tûr′bĭn) Hall
Venice (vĕn′ĭs)
Vikings (vī′kĭngz)
Watt (wŏt), James
West Indies (ĭn′dĭz)
Wheatstone (hwēt′stŭn), Charles
Whitney, Eli (ē′lī hwĭt′nĭ)
Zeppelin, Ferdinand von (fûr′dĭ-nănd fŏn tsĕp′ĕ-lēn′)

INDEX

Africa, 139, 158, 234, 440, 450. *See also* Egypt and Egyptians
Age:
  Iron, 14, 21
  steel, 14, 21
  machine, 14, 91, 95–101, 104–119, 416–417
  Bronze, 21
  Smooth Stone, 21–22, 23–25, 34, 144
  Rough Stone, 22–25
  of scarcity, 102–103, 109
  of abundance, 104–108, 109
Air, or wireless, communication, *See* Radio, communication by
Air transportation:
  airplanes, 128, 218–223, 227, 229, 230, 232
  airships, 207–217
  airports, 224–228
  airmail, 227, 230, 233
  airways, map of, 231
  problems of modern, 259–261
Akron, the, 216
Alloy, 463, 532, 537
America, early:
  transportation in, 161–170, 171, 173–186
  settlers in, 292–293, 330–332, 333–335, 337–338
  Indians in, 293, 322–323, 333–334, 489, 494, 495, 497
  discovery of, 323–330
  European claims for, 329–330
  household system in, 489–497, 500–501
  paper money in, 545
America, land of:
  maps of, 188, 203, 231, 232, 262, 282, 283, 336, 372, 378, 410, 411
America, land of (*Continued*)
  wealth of, in natural resources, 269–271, 285–292, 301, 312, 316–321, 429, 430, 431
  size and surface of, 273–284
  See also Earth, Forests, Grasslands, Metals and fuels, *and* Soil
America, United States of:
  effect of Industrial Revolution upon, 88–89
  government of, and money, 529–553
  See also Banks, Communication, Machines, Tools, *and* Transportation
Animals, using, for transportation, 143, 145–152, 155, 159, 160, 173–178, 181, 182–184, 195
Arkwright, Richard, 70
Assaying and assayers, 535
Assyrians, 41, 47
Atlantic cable, 239–240
Australia, 440, 529
Austrians and the automobile, 196
Automobiles, 125, 126, 128, 196–199, 200–206, 251–254

Babylonians, 41, 58, 153, 467, 478
Balloons, *See* airships *under* Air transportation
Baltimore, 164–165, 181–184, 238–239
Banks:
  and business, 521–528
  savings, 521–522
  Federal Reserve, 523, 546
  as moneylenders, 523–525, 528
  checking accounts in, 525–528
Barter, 444–448, 449, 499–501. *See also* Trade

Bell, Alexander Graham, 242–243
Bessemer converter, 10
Book lists, 16, 29, 133–134, 192, 217, 294, 321, 370, 392, 419, 498
Boone, Daniel, 164
Bronze, 27, 460
Bronze Age, 21
Burdens, means of carrying:
  modern, 121–122
  pack, 137, 138
  porters and stevedores, 138–141
  litter (dooli, sedan chair, palanquin), 141, 143
  sledge and drag, 142, 144
  See also Animals *and* Wheels
Bureau:
  of Standards, 513–516, 517, 518, 531–532
  of Engraving and Printing, 530, 547–553
Bus routes, map of, 203
Business:
  consumers, creators of, 425–427
  defined, 427
  See also Trade
Busses, *See* Automobiles
Buying and selling:
  money used in, 501–505
  institutions for, 505–510
  See also Trade

Cable, Atlantic, 239–240
Canals, 165–167, 170, 171
Carriages, 177, 178
Cartwright, Edmund, 70
Cattle, raising, 350–352
Chanute, Octave, 218
Charcoal, 74, 75
China and the Chinese, 41, 62, 140, 143, 153, 257, 461, 462, 470, 478, 529
Citrus fruit, climate and soil for, 274
Civilian Conservation Corps, 369–370
Civilization:
  money, 412–418, 426, 499–505
  moneyless, 435–456, 473–497, 499–501
  machine, *See* Machine Age
Clerk-Maxwell, James, 244–245
Clermont, the, 168
Cleveland, 7, 8
Clinton, Governor De Witt, and the Erie Canal, 165
Coal:
  use and mining of, 74–77, 78–79, 82, 87, 371–374, 375, 392
  a natural resource, 269–271, 291–292
  formation of, 313–317
  conservation of, 374–376, 395, 397
  as wealth, 430
Coins:
  early, 462, 463–466, 486–487, 489, 496, 497
  importance of, today, 499–505
  money-changers and, 520–521
  foreign, 529–530
  value of, 532–534
  making, 535–543
  storing of, 543
Colonial America, *See* America, early
Columbus, Christopher, 160, 326–327
Commodity:
  used in place of money, 449–456
  defined, 452
  See also Money *and* Trade
Communication:
  underground, 122–123
  by wire, 123, 131, 235–243
  wireless, or radio, 123, 130, 244–249, 263–265
  primitive methods of, 234–235
  by cable, 239–240
  See also Transportation
Conestoga wagons, 175–176

Consumer:
defined, 401
types of, 401–409, 412–416
money used by the, 401–403, 426
principal wants of the, 420–425
a creator of business, 425–427
See also Trade
Consumption goods, 415–416
Contour plowing, 362, 363
Cooke, William, 235
Cooper, Peter, 181–184
Copper:
as a natural resource, 26–27, 269–271, 291–292, 301, 387–388, 390, 391, 392
use of old, 389
used as money, 456–463, 532
Corn and cotton, climate and soil for, 273–274
Cover crops, 362, 363
Craftsmen and factory hands, 85, 98–101

Diesel engine, 251–252
Dirigibles, *See* airships *under* Air transportation
Drake, Edwin L., 320
Dry farming, 352–355
Duluth, 4–7
Dust bowl, 361
Dynamo, *See* Generator

Earth, the:
origin of, 296–301
soil formed on, 302–312
coal formed in, 313–317
oil formed in, 317–321
See also America, land of, Forests, Grasslands, Metals and fuels, *and* Soil
Edison, Thomas, 239
Egypt and Egyptians, 38, 41, 44, 46, 57–58, 62, 153, 455, 459, 465, 467, 468, 473–475, 477–478
Electrical:
power, 77, 93–97
communication, *See* Communication
Elizabeth, Queen of England, 160
Engines:
steam, invention of, 77–83, 167–168
gas, 77, 93
uses of, 88–89
steam turbine, 92–94, 96
automobile, 93
See also Railroads
England (British Isles):
becoming a separate nation, 61
need for better tools in, 61–63
inventions of machines in, 64–72, 77–79, 81–83, 167–168
factory system in, 72, 84–89
fuel problems in, 73–74
mines and mining problems in, 74–77, 179, 371
Industrial Revolution in, 85–89
early steamboats in, 167–168
early railroads in, 179, 180
and electrical communication, 235
and radio, 244, 247
claims of, in New World, 329
colonial trade with, 339–340, 493, 494
money in, 496, 501, 502
See also Middle Ages in Europe
Engraving and Printing, Bureau of, 530, 547–553
Erie Canal, 165–167, 170
Erosion of soil:
defined, 302
by water, 303, 304, 306–308, 356–360, 362, 364–366
by glaciers, 303, 305
by wind, 307–308, 309, 310, 356–357, 360–361, 365–366
plans for prevention of, 361–370, 394–395, 396, 397

Europe:
tools and machines in, 58, 60–63
Industrial Revolution in, 87–88
World War in, 353–355, 373
See also Middle Ages in Europe
European explorers and their discoveries, 326–330
Exchange, medium of:
defined, 450
use of, in trade, 450–456
a measure of value, 451–452
See also Trade

Factories:
first, in England, 70–72, 82, 83
steam power in, 73–83
effect of, upon ways of living, 84–89
electrical power in, 93–94, 99–101, 105
workers in, 99–101
overproduction in, 104–108
Factory system, 72, 73, 83, 84–89
Farmers:
as producers and consumers, 403–406, 410, 411, 412
in Egypt, 475, 477
Farming:
variety of soil for, 270, 273–274, 286, 311–312
clearing of land for, 284, 285–287, 333–335, 337–338, 348–349
dry, 352–355
See also Soil
Federal Government, *See* America, United States of
Federal Reserve Banks, 523, 546
Feudal system, *See* Middle Ages in Europe
Field, Cyrus W., 239–240
Fires, forest, 345, 346
Flint, tools of, 23
Floods, 362, 364–366
Florence, bankers in, 521
Forests:
a natural resource, 269–271
clearing of, for settlements, 285–286, 333–335, 337–338
products of, 288–290, 338–342
primeval, 313–314
lumbering of, 341–345
abuse of, 341–342, 344, 345
fires in, 345, 346
conservation of, 346, 347, 393–396
work of CCC men in, 369–370
as wealth, 430
France, 61, 78, 87–88, 160, 196, 209, 210, 212–213, 329, 339, 371, 496, 502, 529
Friction, force of, 40–41
Fuels, *See* Metals and fuels
Fulton, Robert, 168
Furnace (blast and open-hearth), 8–10, 11

Gale, Prof. Leonard D., 237
Gama, Vasco da, 325–326
Generator, electric, 77, 93–97
Germany, 61, 87–88, 196, 213–215, 218, 219, 244, 371, 502
Giffard, Henri, 212–213
Glaciers, erosion by, 303, 305
Gliders, 218–220
Gold, 270, 301, 431, 463, 532, 534, 536–537, 543
Graf Zeppelin, the, 214–215
Grasslands:
cleared for farming, 337, 348–349, 352–353
used for grazing, 350–352
See also Erosion of soil
Gravity, force of, 40
Great Lakes, transportation on the, 5–8, 165, 170, 171, 172
Greeks, 38, 41, 58, 62, 461, 463, 464, 466, 467, 476, 478, 522

Hargreaves, James, 67–68
Hero of Alexandria, 77, 78, 79
Hertz, Heinrich, 245

Hindenburg, the, 214–215
Homestead Act, the, 353
Horses in transportation, *See* Animals *and* Vehicles
Household systems:
in ancient civilizations, 473–478
in Middle Ages, 480–488, 500
in colonial America, 489–497
Hydroelectric plants, 94, 96, 374–375
Hydrogenation, 386–387

India, 140, 141, 149, 324–327
Indians, American, 153, 161, 162, 174, 186, 235, 293, 322–323, 333–334, 489, 491, 493, 494, 495, 497
Industrial Revolution, 84–89, 371–372
Ingots, or bars, 536
Iron Age, 14, 21. *See also* Machine Age
Iron, melted (pig iron), 10, 11
Iron ore:
mining of, 3–4, 87
shipping, 5–8
making, into steel, 8–12, 27–28, 74
as a natural resource, 269–271, 291–292, 301, 388, 392
as a commodity, 460
Isabella, Queen of Spain, 326
Italy, 143, 208–209, 246–247

Jackson, Dr. Charles T., 237
Jenkins, Francis, 264

Kay, John, 66–67
Kettleman Hills, 385–386
Khan, the Great, 470

Lana, Francesco de, 208–209
Land, *See* America, land of, *and* Earth, the
Lead, 269–271, 291–292, 301, 387–388, 389, 392
Lilienthal, Otto, 218, 219, 220
Lindbergh, Charles A., 224
Lumbering, *See* Forests

Machine Age, 14, 91, 95–101, 104–119, 416–417
Machines:
of steel, 14
need for, 40–41
principles of, 41–42
lever, 42–43, 45, 47, 50
wedge, 43, 45, 50
inclined plane, 43–44, 45, 50
wheel and axle, 44, 50
pulley, 45, 46, 47, 48, 49, 50
screw, 45, 46
power for, 52–58, 73–83, 91–97
effect of, on industry and civilization, 84–89, 98–101, 104–108, 109–111, 112–114, 115–117
Macon, the, 216
Maps, 188, 203, 231, 232, 262, 282, 283, 336, 372, 378, 410, 411
Marco Polo, 470
Marconi, Guglielmo, 246–247
Medieval towns, *See* Middle Ages in Europe
Mediterranean Sea, 60, 458
Mesabi Range, 4, 5, 10
Metal:
tools of, 25, 26–28
used for money, 456–466, 535–543
Metals and fuels:
a natural resource, 269–271, 301
wealth and use of, 291–292
conservation of, 387–391, 393–397
See also Coal, Copper, Gold, Iron ore, Lead, Oil, Silver, *and* Zinc
Middle Ages in Europe:
tools in, 58
transportation in, 143

Middle Ages in Europe (*Continued*)
credit money in, 471–472
household system in, 480–488, 500
colonial America compared to, 490
banks established in, 521
Middlemen, 510
Minerals, *See* Metals and fuels *and separate headings*
Mining:
for iron ore, 3–4, 87
for coal, 74–77, 78–79, 82, 87, 179, 371–374, 375
Minnesota, 4–6, 7
Mints, 535–536
Money:
civilizations, 412–418, 426, 499–505
and wealth, 428–431
civilizations using little, 435–456, 473–497, 499–501
barter in place of, 444–448, 449–456, 499–501
use of various commodities as, 449–456
use of copper or other metals as, 456–466
early credit, 467–472
in trade today, 501–505
banks and, 521–528
foreign, 529–530
and the Treasury Department, 529–531
values of, 532–534, 545–547
making metal, 535–543
storing of, 543
making paper, 547–553
Mongolia and Mongolian money, 469–470
Montgolfier, Jacques and Joseph, 209, 210
Morse, Samuel Finley Breese, 237–239, 242
Motors, *See* Automobiles
Moving belt, 99, 100

Nation:
defined, 269
resources of, *See* Resources, natural
Newcomen, Thomas, 78–79

Obulus, 457–459
Oil:
a natural resource, 269–271, 291–292
formation of, 317–321
fields and their supply, 377–378, 379, 380, 392
waste of, 379–384
conserving, 384–387, 393–397
Oil pool, diagram of, 320
Ore, *See* Iron ore

Paper money:
values of, 545–547
making, 547–553
Papin, Denis, 78
Petroleum, *See* Oil
Pictograms, 354, 367, 368, 384, 392, 426
Pig iron, 10, 11
Pitcher, Percy, 218
Polo, Marco, 470
Power for tools and machines:
animal, 52–54, 60, 74–75
human, 52, 54, 55, 60, 74–75, 76
wind, 55–56, 60, 62
water, 56–58, 60, 62, 70, 71
mechanical, 73, 77–83, 84–89, 91–97
fuel for, 74–75
Prime movers, 94–95, 97
Producer:
types of, 403–409, 412, 415–416, 433
creation of business for the, 425–427
See also Trade
Production goods, 415–416
Programs for using natural resources, 396–397

Proration, of oil, 384–385
Public conveyances, 200–206, 255–257. *See also* Air transportation *and* Railroads
Pyramid, the Great, 41

Radio, communication by, 123, 130, 244–249, 263–265
Radiotelephone, 263
Railroads:
  of today, 121, 122, 124, 129, 187–191
  engines, or locomotives, for, 167–168, 179–180, 182–184, 256, 257
  beginnings of, 170, 179–186, 187, 195
  map of, 188
  problems of, 255–259
Resin, 290
Resources, natural:
  defined, 269–270
  variety of, 273–275
  developing, 292–294
  conservation of, 393–397
  See also Forests, Metals and fuels, Soil, *and* Wealth
Revolution, Industrial, 84–97
Roads, 157–160, 164–165, 173–177, 199
Rocks, in soil formation, 302–312
Rome and the Romans, 41, 58, 60, 62, 157–160, 465, 480, 487

Santos-Dumont, Alberto, 213
Sap, from trees, 289–290
Sault Sainte Marie, 170, 171
Savannah, the, 168, 169
Savery, Thomas, 78
Sawmills, 343–344
Serfs, *See* Middle Ages in Europe
Services and wealth, 401, 402, 406, 412–415, 425–426, 433–434
Sheep, raising, 351–352
Shipbuilding, 339
Signals:
  primitive, 234–235
  of today, 236
  See also Communication
Silver, as money, 463, 464, 467–468, 532, 533, 536–537
Smiths, 27, 30, 31, 98
Soil:
  a natural resource, 269–271
  kinds of, 273–274, 311–312, 357
  uses of, 284, 285–286
  formation of, 302–312
  erosion of, 302–310, 347, 356–370
  conserving, 361–370, 393–397
South America, 139, 440, 446
Spinning:
  wheels, improvements in, 64–72
  jenny, invention of, 67, 68
Stagecoaches, 173–174
Standards:
  setting national, 513–518
  Bureau of, 513–516, 518, 531–532
Steam:
  used for pumping, 77–80
  used to run machinery, 80–83, 91–93
  turbine engine, 92, 93, 94, 96
  engines, 167–168, 179–184, 195
Steamboats, 167–168, 169, 170, 171
Steel:
  process of making, 8–11
  uses of, 12, 13, 14, 21
  age of, 14, 21
Stephenson, George, 179
Stone Age, 21–25, 34

Telegraph, the, 235, 237–239, 240–241, 244
Telephone, the, 242–243, 244. *See also* Radiotelephone
Teletype, the, 240, 241

Television, 264, 265
Tigris-Euphrates, *See* Babylonians
Tin, 27
Tom Thumb, the, 182–184
Tools:
  iron and steel, 14, 21
  earliest invention of, 18–20
  bronze, 21, 27
  stone, 21–25
  flint, 23
  wood, 24–26
  metal, 25, 26–28
  copper, 26–27
  percussion, 29–31
  for cutting, 32–34
  for grinding, 34–36, 37
  for holding, 37
  for measuring, 37–38
  improvement of, 60–72
Trade:
  in early Europe, 323–326
  barter, 444–448, 449, 499–501
  medium of exchange in, 450–456
  use of metals as money in, 456–466
  early credit money in, 467–472
  money and, today, 499–505
  institutions for, 505–510
  See also Business, Consumer, *and* Producer
Transportation:
  of iron ore, 5–8
  modern, 121–131, 262
  animals, an aid in, 143, 145–152, 155, 159, 160, 173–178, 181, 182–184, 195
  wheels, an aid in, 153–156, 157–160, 173–178
  roads, an aid in, 157–160
  in early America, 161–172, 173–186
  See also Air transportation, Automobiles, Canals, Railroads, Steamboats, *and* Vehicles
Travel, *See* Transportation
Treasury Department (of the United States):
  and the money system, 529–531
  money stored in, 543–544
  superviser of money-making, 547
Tribal ownership, 440–443
Trucks, *See* Automobiles
Turkey, 138–139
Turpentine, 290

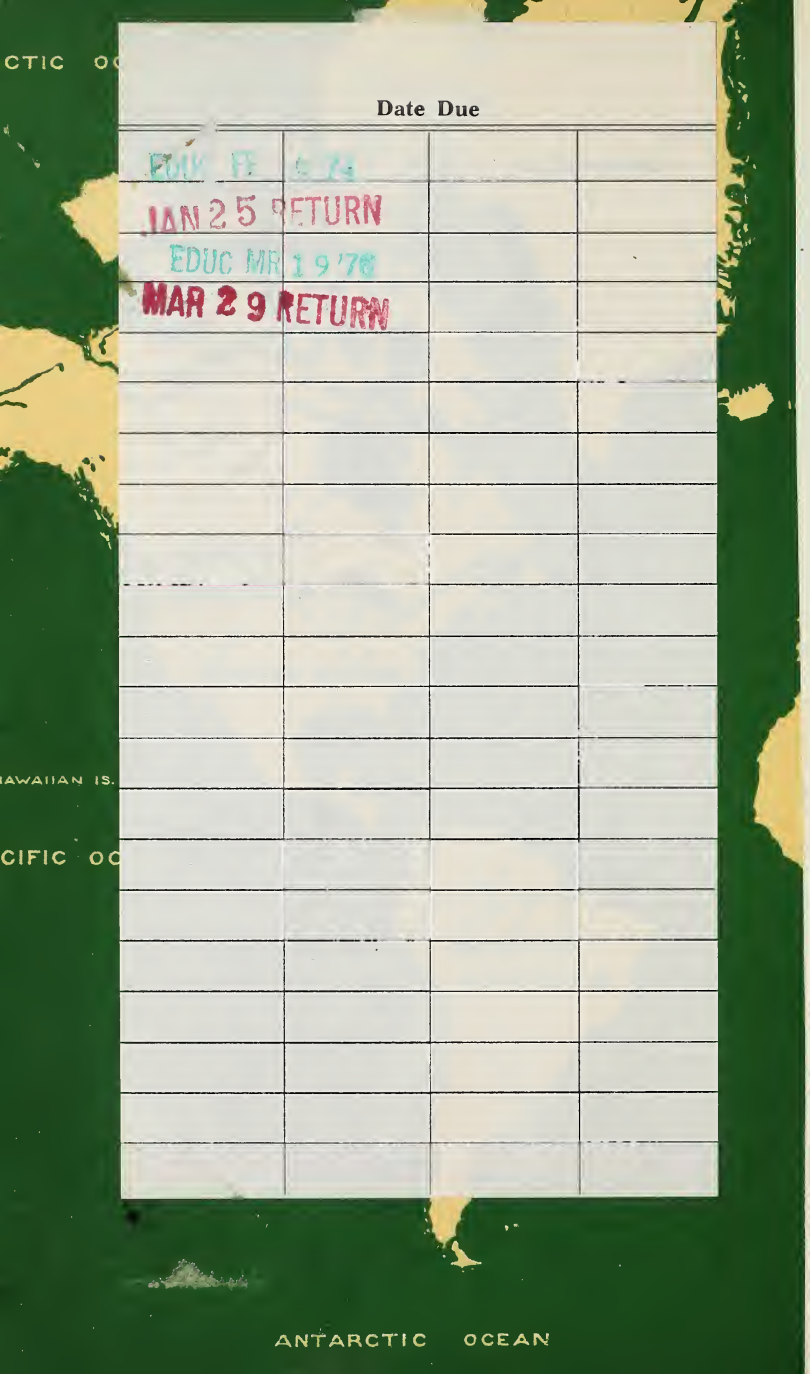
United States of America, *See* America, United States of
Unitization, 386

Vail, Alfred, 237, 239
Value, measure of, *See* Medium of exchange
Vehicles:
  propelled by humans, 122, 141, 142, 143, 144, 154
  elevated trains, 126
  streetcars, 126
  motor trucks, 121, 122, 126, 198, 201
  drawn by animals, 143, 145–152, 155, 157, 159, 160, 173–178, 181, 182–184, 194–195, 197
  busses, 121, 122, 198, 202, 203
  traffic problems of, 204, 205–206, 253
  See also Automobiles, Railroads, *and* Transportation
Venice, stalls of money-changers in, as the first banks, 521

Water, a cause of soil erosion, 303–307, 308, 356–370
Watercraft and waterways, 121–122, 124, 127, 142, 144, 161–172
Watson, Thomas A., 242
Watt, James, 81–83, 84, 91, 95, 167, 179

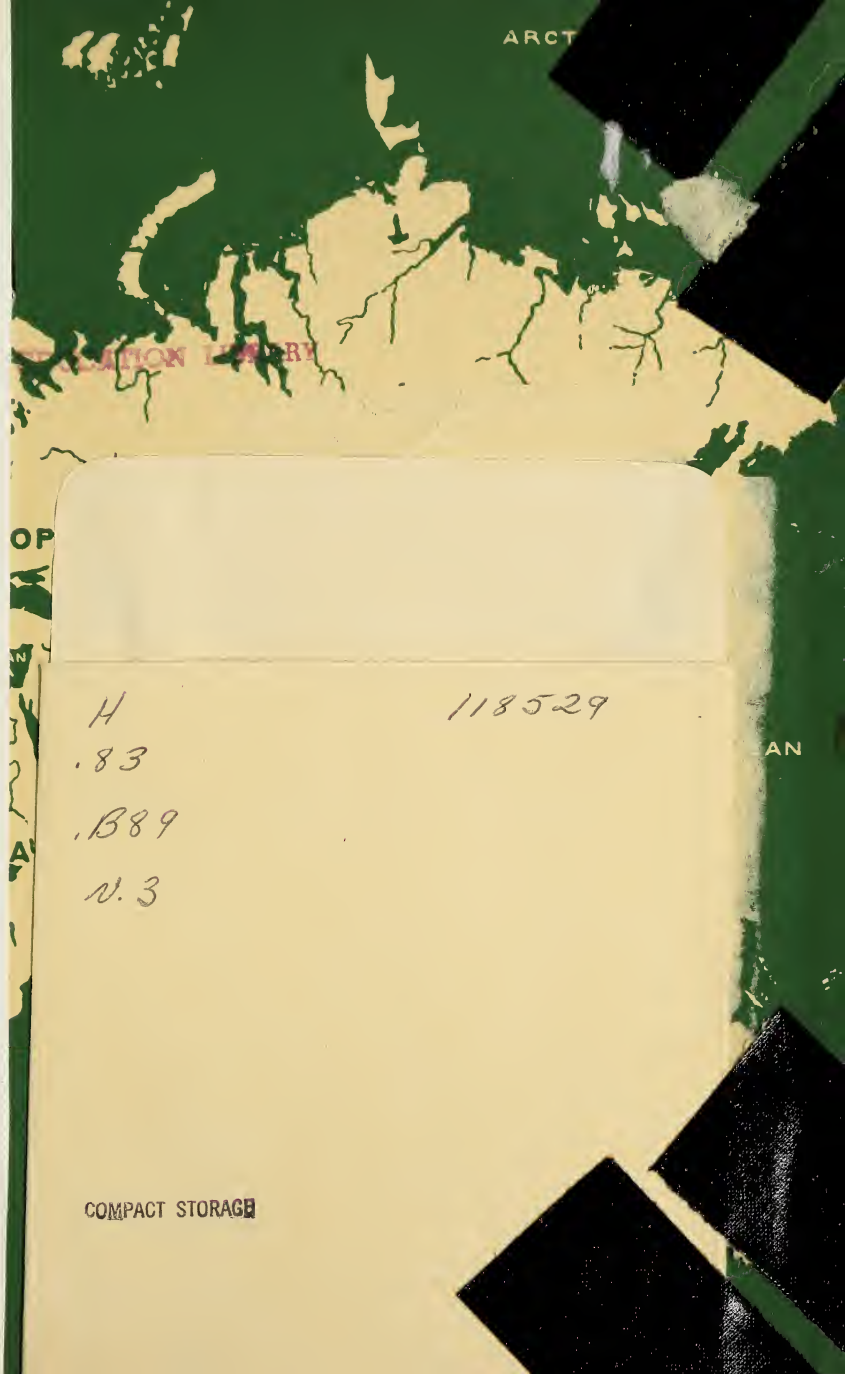
Wealth:
services and, 401, 402, 406, 412–415, 425–426, 433–434
money and, 428–431
qualities of, 429–431
a natural resource, 429, 438. *See also* Resources, natural
development from free goods, 435–439
weapons as the first, 437–439
group and private, 440–443
Weapons, *See* Tools
Weaving, 64–72, 83, 98
Wheatstone, Sir Charles, 235
Wheels, 153–156, 157–160, 173–178. *See also* Vehicles
Wind, a cause of soil erosion, 307–308, 309, 310, 356–370
Wireless, *See* Radio
Wires, 123, 131, 235–243, 244
Wood:
tools of, 24, 26
as fuel, 74
See also Forests
Workers:
effect of Industrial Revolution upon, 84–97, 98–101, 115–117
effect of overproduction upon, 104–108, 112–114
World War, the:
and the farmers, 353–355
and the miners, 373
Wright, Orville and Wilbur, 219, 220, 221

Zeppelin, Count Ferdinand von, 213–214
Zinc, 269–271, 291–292, 301, 387–388, 389, 392



Date Due

EDUC FEB 6 '74
JAN 25 RETURN
EDUC MR 19 '76
MAR 29 RETURN

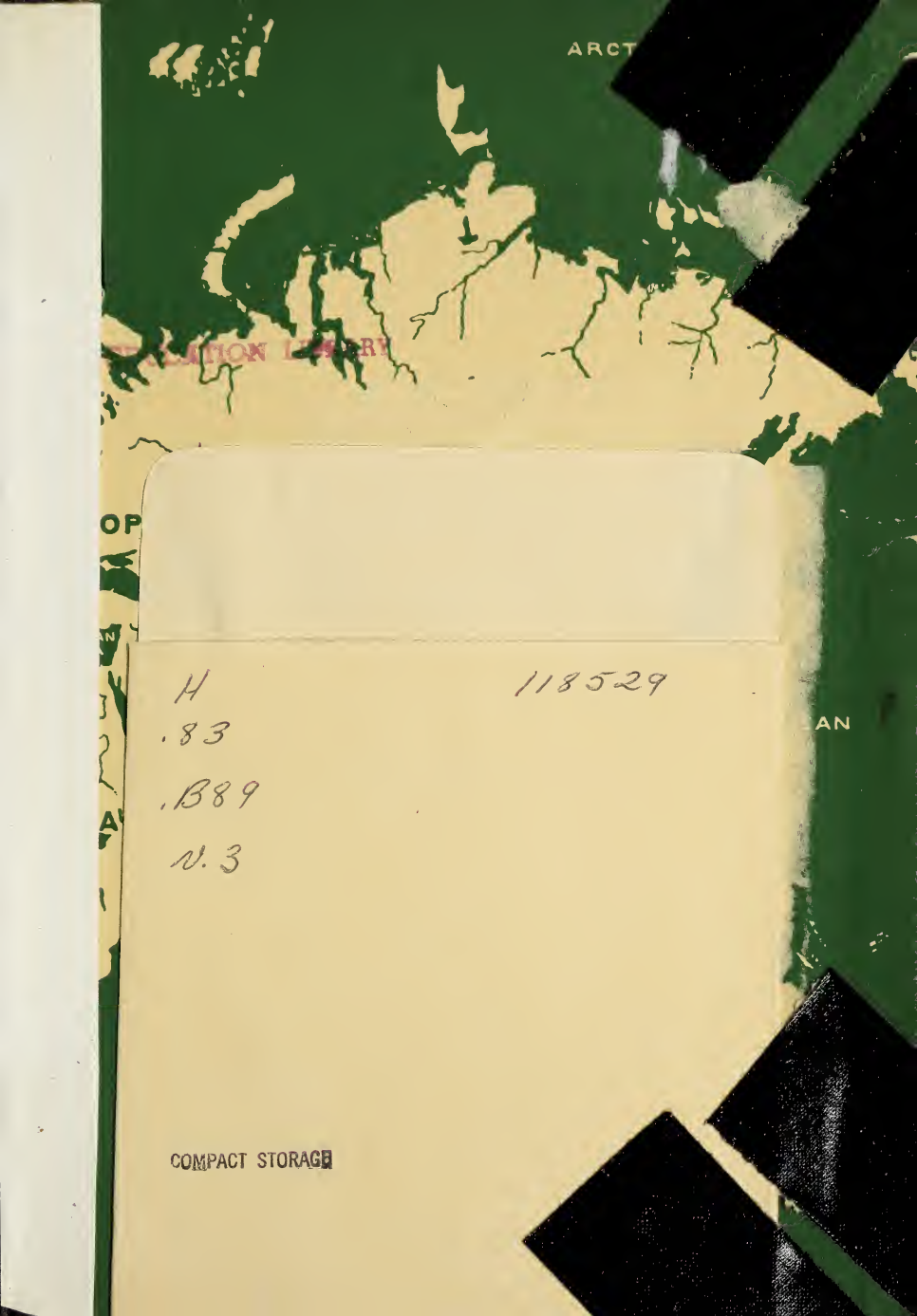


H
.83
.B89
v.3

118529

COMPACT STORAGE

ARCTIC OCEAN
GREENLAND
NORTH AMERICA
UNITED STATES
ATLANTIC OCEAN
HAWAIIAN IS.
PACIFIC OCEAN
SOUTH AMERICA
ANTARCTIC OCEAN



H
.83
.B89
v.3

118529

COMPACT STORAGE

H 83 B89 v.3 c.1
Bruner, Herbert Bascom, 1
Social studies; intermediate g
EDUC
0 0004 3286 905
A5283